IMPERIAL BUREAU OF ANIMAL NUTRITION
16 JAN 1947
INSTITUTE

THE

Journal of the

AUSTRALIAN INSTITUTE OF AGRICULTURAL SCIENCE

PUBLISHED QUARTERLY

J. Aust. Inst. agric. Sci.

SUBSCRIPTIONS: Within Australia 10/6, British countries 11/6, Foreign countries 12/6 per volume of four numbers, and 3/-, 3/3 and 3/6 respectively per copy, post paid.

Issued Free to Members of the Australian Institute of Agricultural Science.

Registered at the G.P.O., Sydney, for transmission by post as a periodical.

VOL. 12, No. 3. SEPTEMBER, 1946.

CONTENTS

Mixed Farming.....by John Green 69

The Seventh Report of the Rural Reconstruction Commission—Rural Amenities.....by R. P. Roberts 79

Farrer Oration, 1946.....by H. Wenholz 88

The Organisation of Soil Conservation Work in South Australia.....by R. I. Herriot 92

Æolianite and Soil Formation in Western Australia.....by L. J. H. Teakle 95

Tests with Benzene Hexachloride and D.D.T. Incorporated in the Soil for the Protection of Crop Plants from Black Beetle.....by C. R. Wallace 96

Soil Carry-over of the Bean Halo Blight Disease.....by R. D. Wilson 103

Technical Notes—

The Resolving Power of the Eye and the Estimation of Fibre Thickness.....by W. R. Lang 108

Potassium Deficiency in Citrus.....by R. H. Arnot 110

The Australian Institute of Agricultural Science..... 114

Current Notes and News..... 117

Personal Notes..... 119

The Institute accepts no responsibility for the accuracy of statements made or opinions expressed in contributed articles or letters.

AUSTRALASIAN MEDICAL PUBLISHING COMPANY LIMITED

The Journal of
THE AUSTRALIAN INSTITUTE OF AGRICULTURAL SCIENCE

Registered at the G.P.O., Sydney, for transmission by post as a periodical.

Editor : D. B. ADAM, B.Agr.Sc. **Business Manager :** C. S. PIPER, D.Sc.
Address : Waite Institute, Private Bag, Adelaide, S.A.

Vol. 12, No. 3 SEPTEMBER, 1946

Mixed Farming*

By JOHN GREEN,
Director of Farming and Gardening Services, British Broadcasting Corporation.

Let me be quite clear before I start to talk about Mixed Farming. I am discussing an ideal. We must have ideals, just as the stock breeder would never have got anywhere without those early pictures in his mind of ridiculously square animals that never were on land or sea. When I refer, therefore, to Mixed Farming, with a capital M and a capital F, I am referring to such an ideal—to possibly the most highly developed conception of agriculture which has yet been held by man. Because it is an ideal, you must not ask me where or when it has existed in practice, but only the circumstances under which the idea has existed. We haven't had a new ideal in farming since Virgil wrote the Georgics. Throughout the intervening centuries of subsistence farming man had little time for ideals, but there has sounded a similar note of enthusiasm, of grace, from the days of Tusser to Coke of Norfolk. So I want to talk tonight about English mixed farming (I say English advisedly, although it is one of our British paradoxes that it is mostly practised by Scotsmen).

First, why is any form of settled farming significant ? I think the answer is that it arises from an inherent superiority of man. Once as a hunter, he competed with the animals for food ; as a farmer, he has controlled his whole environment to his use. Man has used his greatly extended powers to regulate the symbiosis of himself with his animals and his plants. A rudimentary triumph of will has become a final triumph of organization. I assume that if man wants to continue his superior existence (and is not in the suicidal frame of mind of some of our modern materialists), he will try to remain the husbandman and not dive back into the icy flood of competition with elements he has subdued. He will not be satisfied with any more primitive form of migratory farming such as burning out a patch of forest and passing on when the land is exhausted. I am not trying to be funny when I say there are plenty of English and Australian farmers who still do this when they can get the chance.

I think man will not ultimately be satisfied even with pastoral farming, though its glories be sung by the silver-spurred cattlemen of Spanish America, the Arab, or the Merino flock master. I am sensible enough to wish to delay its passing wherever possible, but I believe that mixed farming is in the natural course of evolution. Wherever the environment is capable of supporting a quickened enterprise. I think the criterion must eventually be activity, not area ; the station will slowly yield to the farm.

* Address to a meeting of the Melbourne University Agricultural Society, 2nd August, 1946.

Now I want at this stage to make one or two points quite clear. First, the transition to mixed farming must be justified by the capacity of the land to increase its productiveness or the demand of some accessible market for its produce. Mixed farming is not an end in itself. Secondly, mixed farming has a short term economic saturation point at which the increased production may not justify increased activity (a point that in my view has often been reached in Britain and to which I want to refer later). Thirdly, there is a moral limitation to the amount of activity that can be supported without damage to the capital value of the soil. We cannot entirely forget the words of the Collect for plenty of the Church of England, where we pray " that our land may continue to yield us its fruits of increase ". " Fruits ", remember, not plants ; " increase ", not substance.

We now come to the historical moment whence we derive this ideal : a very important consideration. You can say that it is absolutely associated with the industrial revolution, with the growth of modern towns and the secondary employment that a mechanical age made possible. Of course there had always been cities, and many of them were obliterated eventually by the deserts of their own creating, while the growth of others had been checked by the territorial interests that still held the reins of government. But not until the 17th century, after the implications of the New Learning had been absorbed and the theories of Mechanics enunciated, did the modern manufacturing city, as we know it, acquire a clean conscience and the natural order of life seem to fade into the background, while man's manipulative powers over his universe so greatly extended.

That man was still limited by his cereal resources for food and clothing seemed difficult to believe, or that there were still natural bounds to these congregations for industrial purposes. Do we realize sufficiently the impact this must have made on the minds of those people who were still responsible for the control of land in England and in northern Europe generally ? Can we understand now why Lord Townsend resigned the Secretaryship of State to grow turnips, or why the ambitious Coke absolved himself from the political turmoils of the Napoleonic wars to reclaim the marshes of north-west Norfolk ? I think we must still look in this direction if we are to understand the problems of land use and control under closer settlement and appreciate the significance of mixed farming. For there can be no increase of population anywhere without an increase of food and clothing, and no increase of those without a higher organization of land resources.

What was this mixed farming organization in effect ? It was something new. From the point of view of land control it became a landlord and tenant system, or perhaps you might call it a form of share farming for closer settlement. It had nothing to do with the old manorial system it supplanted, which was largely political, or the pastoral system whose early profits had built our English churches and grammar schools and dignified the title of " grazier " until the 18th century. It represented a division of labour in accordance with the prevailing economic theories and allowed for an organization of the farm for profit as well as for subsistence. Looked at another way, it was a division of interest between conservation and exploitation. I don't mean that every landlord conserved or that every tenant exploited (indeed many landlords overcharged their estates and many tenants understocked their farms), but the system allowed for a more exact attention to detail whereby Britain raised permanently her level of food production to meet the needs of the industrial revolution. I only wish I had access to some of the covenants in leases to give some idea of the restrictions that estates imposed on their tenants, or could cite instances of the way credit was controlled through the regulation of rents. It is perhaps sufficient if I remind you that the most opprobrious term that can still be used of a farmer at home is that " he farms to quit ", and if in a democratic country you have any doubts as to how the other side of the bargain was kept, you should one day make a pilgrimage to Holkham and read the inscription on Coke's monument.

I do not want you to think that I am dwelling unduly on the political aspects at the expense of the technical. I must stress this side first to show that the main feature of mixed farming, whether practised under the landlord or tenant system or in any other way, is the conservation of what is known in law as the hereditament or that interest in land which under any system of government belongs to the future. We may well ask who looks after the hereditament in these enlightened days when the urban voter swings the poll which ever party is in power ? Certainly in Britain death duties on agricultural land have undermined the conservative influence of the landowner. It is perhaps a greater irony that those death duties are used by the State as income. Yet can we blame modern socialism for this state of affairs when it was the older Mercantile system that regarded rent as interest on capital investment instead of regarding it, as I believe it should be, as a restitution of loss from usage ? It is not the particular brand of political theory which is to blame, but rather the fact that so many emanate nowadays from an urban point of view. When landlords put the profits of their lands in houses and other tangible conceits, we at least knew waht they had robbed from the soil, and some of the results were very graceful and attractive. Today there is no intelligent control of land occupation, either through finance or by a regulation of cropping practices. And who has ever looked after the hereditament in the New World ? It appears that the question of land as a hereditament has never been an idea because the land was not opened up until it was universally regarded as the complement of the mine. Although the early free traders only looked for a wider exchange of the world's resources than was possible within the nation State, the fact remains that since the first New Englanders crossed the Alleghanies, land has been openly exploited in the interests of transport and finance and the big cities.

There is perhaps nothing fundamentally wrong in a country spending its first-fruits on laying the foundations of its ultimate civilization. I have already said that England built its churches and grammar schools out of its pastoral fortunes. It was fortunate, too, in accumulating these profits at a time when it had no expensive railways, roads or telephones to provide. But have sufficient of the New World's first fruits provided for permanent features like churches and schools or education, or productive features like communication and irrigations ? I can't see that it matters if the profits are taken in private enterprise and paid back in the gift of some research institute, or if, in more socialistic times, they are taken direct from the taxpayer to erect a state college. In either case the profits of the land ultimately benefit the land. It is rather different if the golden fleece has merely raised ornate offices or been cashed out in contemporary salaries, particularly—and this is where it concerns my subject tonight—there is too little credit left for the costly transition from a pastoral to a mixed farming system. A transition which in these days cannot be gradual but which must represent a leap since it is not a case of breeding two foals to replace six oxen, but of buying a tractor from the U.S.A.

I want finally, while discussing land control, to return to the English example, because it is important. At the end of the 18th century England had to make this same transition from pastoral to mixed farming. Fortunately, in those days additional profits from the land were also passing in the form of mineral royalties to the landowners. We are apt to overlook today the extent to which the landowners thus subsidized British agriculture last century. That is not happening here even if much urban wealth is going into the properties of Collins Street farmers. In England after the Napoleonic wars the investment in drainage alone was prodigious ; the all-conquering Duke of Wellington himself was numbered among the great drainers. Then again between the 40's and 60's which saw the close of the inflationary period, most of our spacious farm buildings were erected with the landlords' accumulated profits. My point is that the division of interest between landlord and tenant brought to the land the capital equipment necessary for the transition to mixed farming or closer settlement in a way that identified it with the

hereditament. It brought into existence a system of credit that financed development according to the capital interest in the land.

Finally, please don't think I am advocating the landlord and tenant system as such, especially for use in countries where it has no traditional place. I am merely pointing out the fact that it is a prerequisite of mixed farming that either accumulated profits or external subsidies must be available to finance its transition from pastoralism and that some humane control of it is later inevitable.

From the foregoing, my main criterion of mixed farming will be evident. It is that it should be conservative of the hereditament, whether the heir be the Duke's son or the next generation of the people. It is essential that the increased activity on the land should not be at the expense of the land. How, then, can this be assured from the technical point of view? Our European forebears, faced with the heavy demands that feeding an industrial population would make on their soils, adopted and enforced a system of crop rotation. They sought a way to offset the increase in production by a corresponding increase in the residues returned to the soil and at the same time to speed up turnover by reducing the actual periods of recuperation under fallow. There is no satisfactory explanation of rotational farming except as a principle of life. All habits are boring, and unfortunately good habits may become virtuosity. The trite saying, variety is the spice of life, is a far better explanation of rotational farming than any more accurate description of the different planes on which plants make their demands on the soil or the manner in which certain residues favour the growth of consequent crops. Crop rotations are in effect a form of manuring which we should better appreciate if we spoke more accurately.

I expect most people here know that manure means " manœuvre ", so that the soil's physical condition is as important as its chemical. When we manure a soil we are, in effect, massaging it, toning it up, keeping it infinite in variety, stopping it becoming dull and bored, in short, keeping it alive. The fact that we regard nowadays only the nutriments that we add to the soil as manures can be largely explained by the disproportionate status of chemistry at the time when increased production became so necessary a hundred and fifty years ago. The rotation of crops was a way of actually conditioning the soil by the presence of plant life at a variety of levels and by the introduction of the cloven-hoofed animal for the conversion of residues and for consolidation. But remember that although the cycle of plant and animal life was intensified the amount actually carried away from the soil was carefully regulated by local custom as well as covenant. Despite the discovery of superphosphate, it was realized there could be no substantial addition to the geophysical endowment of the soil.

The advent of the turnip was really only an incident in the development of rotational farming. It perhaps ranks a little large in our ideas now, for a variety of historical reasons, which are quite understandable since it was probably more important in its generation than the atomic bomb. It ended the spectre of winter famine and with it the traditional glories of the Maypole when life became born afresh. It gave our ancestors in the northern hemisphere their final victory over the seasons. It meant level employment of labour and capital throughout the year, and made all subsequent improvements in stock and machinery possible. It is really little wonder that a cabinet minister resigned to further its culture, that the British King almost overlooked the birth of the United States in his enthusiasm for it, or that the Norfolk rotation as practised at Holkham has become a classic. Although we know now the effect the root break has in the growing of white straw crops and the nutritional advantage of succulents in the feeding of livestock, roots are probably less important rotationally than the nitrifying effects of the clover-ley. It is the nitrogen-protein cycle that lies at the heart of our cultural practices and holds some prospect for the continuance of human society.

Therefore I am suggesting that we should only look to the principle of rotational farming and ignore the conventions, particularly when we are so far away from the

country of their origin. However, if we understand the historical associations of these principles I am sure we more easily grasp the reasons for our farming practices. We can imagine, then, how Townshend and Coke might have reacted had they lived in south-east Queensland and had to base their system on melons and peanuts. For example we can be sure that they would have insisted on a variety of cropping to give the maximum intensity of stock and crop husbandry but that they would have set limits to the amount of produce sold from the land so as to balance the residues that would be returned.

Now I don't want anyone to get the impression that I believe a farm can be a self-absorbing, non-exhausting unit. If it were, it would be untrue to life and to the world of nature of which it is a part. The end of all positive living is exhaustion, and it is not in the farmer's power to make our brutish existence on this planet a less melancholy business. Behind every farming enterprise there must be some definite objective in producing food or clothing and therefore some corresponding residual waste, although in the days when man took for his use only the " fruits of increase " and returned all the stalks and bones and even his own excrement, the price of his living was negligible. What I am pleading for is a more highly developed organization of the land rather than these crude systems of monoculture for export. I believe the more highly developed organization to be less exhaustive of the land. I hark back to my " fruits of increase ", for the smaller and more valuable the end product the smaller the residual waste. We experienced the opposite at home in one phase of the war, when we aimed at the greatest possible bulk of wheat and potatoes as an insurance against famine. But even in those days farmers struggled to preserve the structure of their mixed farms and looked to the day when their end products would again be the more valuable sugars and proteins. In view of the long-term nature of the food shortage, this was as well, for fertility would have suffered. There is an old maxim in my part of the world that sums this up : " The man who rides to market lives longer than the man who drives ", meaning that the man who sells stock does better than the man who short-circuits the process by selling his grain.

I have mentioned that even mixed farming must have a definite objective. It is no part of mixed farming to see how diverse the enterprise can be made, as if that were the end in itself. Its purpose is to support a main line of production with so many other activities that every possible residue becomes reabsorbed in the soil. Even in the classic days of the Norfolk rotation, mutton and wool were the main objectives, the constant factors to which all others were subordinated. Round them the farmer planned his general cropping, but this in turn created residues which supported the bullock, the horse, pigs and poultry, not so much as objects of profits as agents for manuring the soil. Most of the activities generated on the farm thus went round in a circle. The sheep provided the manuring for the oats, the fuel for the power unit ; the bullock consumed the surplus sheep fodder of one season to prepare the crop residues for growing their fodder for the next. Nor do I think there was anything sacred about the Golden Hoof. It was just good propaganda on the part of the landowners to put a check on excessive exports from the farm because the arable flock was more or less a constant factor and acted as a fly-wheel on production. It enforced a balanced economy. I am only surprised how long people were in supplanting it by the dairy herd, but this again was no doubt the force of convention rather than of principle.

The prejudice at home against the dairy cow was very great for a number of years. The cow was regarded as a great waster of soil fertility, although the loss from sheep in wool and bone is also pretty considerable. I think the real prejudice against the cow was again historical. When the demand arose for liquid milk, that fine old craftsman the cheesemaker with his ancillary interest in " calf-busting " and pig-fattening, gave way to the producer-retailer. The latter was really a processor of cheap imported fodder and could have carried on without land at all except in so far as he needed it for exercise. The cow, therefore, was an object of

monoculture and socially *infra dig.*, and the mixed farmer only kept her during the depression as a temporary aid in meeting rising costs. It is strange, therefore, that today the dairy has supplanted the sheep flock as the main objective in the mixed farm and our best milk production at home comes now from the sugar beet and grain districts rather than from the traditional pasture areas. As I have said, this is a good example of how principles become obscured for so long by conventions like turnips and golden hoofs. It is not a question of one animal against another, but of bringing any of the animals into a controlled symbiosis with the plants on the mixed farm.

When I say that mixed farming must have a definite objective, I can give a very good illustration from the experience of a rather remarkable farmer at home who from a very small start on about 200 acres in Warwickshire at the end of the last war now owns a freehold estate of some 3,000 acres of the best land in the county. He was a logical sort of person, and when he found that many of his fellow ex-servicemen who had bought themselves into traditional farming at the top of the market were going bankrupt decided he must first secure a market for at least one commodity, then farm backwards. He therefore proceeded to capture and purchase the milk rounds in two of our leading towns, always buying more land and more cows as he required the extra liquid milk. Incidentally he was the first man to sell books of coupons, which obviated bad debts, and he became an early advertiser of clean milk. He was naturally much resented by his neighbours, who clung to their bullocks, and I think always were a little jealous because a branch of the N.F.U. once criticized me for having him on the air, saying that he was " not a farmer, only a milkman, and half daft at that ". Now the moral of this story is that this man is actually a tremendous farmer, whatever else he is. He certainly applied logic and left nothing to chance when he secured his milk-market first, but he did it because he wanted to farm and not because he wanted to produce milk. Today, as he shows you, his marrow-stem kale (which always seems to me to be as big as the sugar cane I saw in Queensland) he boasts of his cultivations and shows you the poverty of his neighbours' land but never mentions milk. His 300-cow dairy of pedigree Ayrshires are milked in open bails, where they tread wheat straw into the ground to restore humus. During the war he planted 120 acres of potatoes without any previous experience (largely, I think, as a gesture to stimulate the more timid members of the local war committee) and averaged 12 tons. He has nearly 100 acres of sugar beet and sows 400 acres of wheat annually, that averaged the year before last 64 bushels an acre. The old corn barns and cattle yards on the land he purchases usually fall into disuse while he builds more simple strategic bases from where he can bring his tractor and fertilizer power to bear to the best advantage. In short, you have here in my view a perfect example of the mixed farm on a scale large enough to allow for the full use of modern equipment, but true to the fundamental principle of one overriding objective supported by a masterly variety of residue consuming and soil enriching subsidiary enterprises.

I must add here a word about labour and machinery. Our farming techniques have changed considerably since the days of Coke of Norfolk. Owing to the use of the internal combustion engine and the improvements that have been made in cultivating and harvesting equipment, each worker's value has been considerably enhanced. This rise makes it imperative that we should attend to the output per unit of labour as well as to our production per acre. However, the case I have just quoted shows that this could be done by enlarging the scope of our management (again I am quite insistent that the solution is not by a reversion to some more crude form of monoculture or peasant holding). The output per unit of labour in Australia is already very high, and by a rough and ready form of calculation, namely dividing the number of employees into the gross takings of the holdings, I have always found it in excess of £1,200 per man—on a wide range of enterprises from orchards to outback stations. In Britain before I left we took for a broadcast series on farm management twelve regional type farms, all a little above the average, from sheep-

runs in Scotland to family farms in Devon and capitalist undertakings in the Fens. The equivalent return was seldom above £600—a pretty striking contrast. However, this does not necessarily mean that Australian farms are more efficient. It may mean that they are rudimentary, and that there is a neglect of fertility and capital expenditure on such matters as drainage and fencing. But it may equally mean that in Britain the yield per unit of area, often £10 an acre, against £1 in a comparable undertaking here, is not justified. Possibly there ought to be a compromise struck between output per unit of labour and output per unit of area, but neither variable should be sacrificed to the overriding consideration of a mixed farming economy whereby the total output per acre is limited to the most highly matured end products and allows for a complete return of residues to the soil. Increased technical efficiency should entail not a more simple employment of a labour force, but an adjustment of the area to allow for a fuller employment of a wider range of crops and soil ameliorative techniques. It should lead to a preservation of the capital value of the land even if it means a lower rate of interest on the financial investment, the labour return, or the area yield.

In this connexion I might cite a personal dilemma. At my home I have made it a point of honour to keep every class of farm stock (excluding, for my shame, bees). This entails, under ideal conditions, keeping some 30 cows, 50 stud ewes and the offspring of up to half a dozen sows to fatten during the winter. Some phosphates and feeding stuffs are brought in to balance exports. This kind of stocking requires 300 acres under fairly intensive cultivation, which includes a limited area under vegetables and employs five whole-time men. My output per acre is about £8, and per man about £500. With wages now about £4 per week, my manager is anxious to put off labour and abandon pigs and sheep altogether and at the same time increase the number of cows. I am for increasing the area so as to enlarge the separate units to an economic level, for as I have pointed out, to do otherwise is to undervalue the quality of the management (which is fairly outstanding) and to reduce the manager to the status of a dairy cocky, while I become a robber of the land by greater sales of liquid milk. Further, we shall not have the mutton that is produced solely on what the cows leave and the bacon that comes from what the greengrocer doesn't want. Under normal circumstances at home I would rather disvalue the land by increasing the area of management at the expense of yield per acre. Obviously such a policy would displace managers, who would then be available for closer settlement in places where land is still underfarmed. (This is an easy theoretical solution, but in practice, who is coming to Australia, me and my manager, or my neighbour?)

If my contention is correct that mixed farming is the more highly developed form of agriculture, it calls for a higher degree of technical competence than the simple processes of monoculture. The shortage in agriculture today is of managers. My admiration for my ex-serviceman farmer in Warwickshire shows that I have no prejudices against soldiers on the land, but what can be more insane than a policy of soldier settlement that puts an ex-captain in the way of becoming a white coolie in a tropical orchard or gives an ex-corporal the opportunities of a captain on the land that he is morally incapable of exercising.

If our politicians persist in perpetuating this age-old folly of the Caesars, I see no prospect of plenty or of preserving for long the world's hereditament in land. Men must be trained for the land, as well as for war or any other profession, and the farming industry must be so ramified as to allow for a wide variety of occupations. Out here there is really only one impressive aspect of agriculture, and that is the station. On the well run station with its hierarchy of manager, overseer, book-keeper and jackeroo, you feel something of that awe in the presence of traditional competence that you feel on a battleship or in a cathedral. The pity of it is that no comparable organization exists in those areas of far greater potentiality that are so often in the hands of men without knowledge either of animal nutrition and crop

husbandry, and who, without subsidies, would dig their own graves and may in the end dig Australia's in loss of soil fertility. Outside the true pastoral districts there are two classes of reactionary who might well ponder the life of Coke of Norfolk; the squatter on improvable land who does exchange his Merinos for harvesters and build cottages, and the worker who, knowing nothing, will not take a wage from anyone who can teach him. Meanwhile it is up to your educational establishments to fit men of all classes to manage the mixed farm. Men who will be professional farmers in control of land and not business men-mechanics, hewing out seams of cereals. As I just said, it is harder to be a farmer than a miner because you have a moral responsibility.

I have inferred that mixed farming always entailed livestock, but that livestock did not always mean mixed farming. I said that the main idea was to reproduce the symbiosis of plant and animal under controlled conditions, because animal residues increased plant growth and in turn gave a protein end product of higher value. However, there is one important consideration. The very existence of animals means loss to the soil. If an animal is milked in excess of its natural propensity, or if too great numbers of stock are reared, there is a net loss. There are many areas of the world that live off other areas in this respect. At home, the stockyard of East Anglia has annually fed meat on to frames that contained some part of the fertility of the Welsh and Scottish hills and of parts of Ireland. In the U.S.A. the feed lots of Iowa annually reduce the mineral reserves of Montana and Wyoming. An even more poignant example is the dependence of one set of pastures on another, as in Leicestershire, where in order to preserve a perfect sward by means of an exact rate of stocking another pasture is usually sacrificed and no beast under two and a half years old is allowed to graze for fear that its bodily development might pull the sacred pasture. It is little wonder that recently the occupiers of some of these pastures which under this system of management can yield more than £20 an acre of meat in a season were unhappy about ploughing them up. But what are we to say generally about this dependence of so many intensive or mixed farming systems on the extensive areas of the world for their stock in trade? I think this question of the deterioration of the store country of the world is agriculture's most urgent problem at the present time. It is so complete at home that it is the limiting factor in our meat industry and the reason for the recent high price of two and a half year old bullocks up to £40 and Scotch ewes for breeding fat lambs up to £5 and £6. Furthermore it is doubtful whether the costs of repairing this outback country by fencing, drainage, bracken cutting and seeding can ever pay the nations concerned, even if regarded in the patriotic light of the T.V.A. I don't know the answer, but there is still time for Australia to consider this matter before the draw-off of stock towards the closer settlement areas develops more strongly. I am not sure that wherever possible all land should not be made to bear its quota of stock rearing and that where this is quite impractical that the finishing lands should not levy a tax to supply minerals and fencing for the store country. We have ample experience that on a free market the rearer always gets the worst of the deal.

In wet store districts I am much in favour of local creameries with the object of separating only the fats of the milk for cash and returning the skim milk to assist the land in its productive effort. (Britain had plenty of cheap healthy stores in the days of farmhouse cheese and butter making.) In the dry districts of the world I think we must rely on the grazier's moderation, or possibly enforce understocking where climate and taxation do not do this automatically

I now must say a word about fodder conservation. This is obviously the key to the artificial control of crops and animals which differentiates mixed farming from pastoralism. The fully developed mixed farming organization cannot be said to exist until its increased plant production is preserved in some way for the use of its increased head of stock. In this way equilibrium is reached between labour and turnover and the farm becomes independent of climate and season. It is because

this is so rarely achieved in Australia and because most improved holdings are only improved grazing farms that I find it embarrassing to answer the question I am so often asked, " What do you think of our farming ? " There is really no farming yet in Australia in the strict sense, because there is practically no fodder conservation, and therefore full-time employment. I don't blame the Australian for still gambling on the climate, because the challenge of a continental climate is considerable and the individualistic tradition that has been inherited from home (indeed carried on in excess of home) leaves the farmer too weak organizationally to master land with such turbulent seasonal fluctuations. However, since I am only proposing a system of mixed farming for the twenty inch *plus* rainfall areas, I think it is fair to point out that in most of these places the farmer already accepts winter grazing as a gift of God but resents provision for an autumn dry period, quite forgetting that his Canadian cousin has six months' winter frost and his Scottish cousin rain throughout his harvest. The Australian also does not realize when he is faced with the task of getting water on to the land how much it has cost at home in the course of centuries to get water from the land. Britain has had to make plants grow in a bog—even if Australia has now to make them grow in a desert. But under both conditions you get periods of surplus growth and the problem is to store these against a dry day as well as the proverbial " rainy " one.

However, I am sure that because the climatic fluctuations here are so great the scale of fodder conservation must be equally large. The 50-ton stack of hay on the small farm in the northern hemisphere must be a pit of at least a thousand tons of silage in this country. The labour and mechanization involved must be proportionately greater and I sometimes wonder how you are going to tackle the social and financial organization involved in achieving this independence of climatic fluctuation. When I was in south-eastern Queensland and in the northern rivers of New South Wales, my imagination sometimes used to run away with me. The challenge was so tremendous, I found myself wondering if sheep would eat bananas in a drought or cows milk well on pineapples ; how many £100,000 or hundred thousand acres I would want ; what kind of housing and villages, to harness those great sub-tropical resources with the same degree of social and agricultural permanence that we expect at home. You must face these issues, because they are the crux of mixed farming, the transition to the independence of horticulture without its walls or glass.

There is a word of caution that should be added here. Fodder conservation is a form of insurance, but you can gamble even with insurance policies. A man is no farmer who over-stocks because he has over-conserved. It is the very essence of fodder conservation that it should be in excess of requirements. I don't think it need be in excess of exceptional requirements, because there will always be times in the best behaved districts where we shall have to sell stock. But the holding of fodder should always be in excess of average requirements. Only where fodder accumulates in excess of this is its sale permissible or a temporary increase of stocking excusable.

A progressive farmer in the western district (who had the misfortune to read economics at my old university !) perplexed me the other day by asking me what was " the value of hay ". Try and answer that for yourself. I felt that the price of hay must always be relative to some purpose for which it was wanted : it certainly must bear some relation to seasonal supply and demand. That wasn't the answer that was required. However, in the case of mixed farming I think I can give my friend an absolute answer : the price of hay or other fodder is the cost of just avoiding a failure in your main farming objective. The fortunes of the mixed farm will fluctuate with the seasons like any other farming enterprise, but once it has become organized to achieve a purpose this must be secured as ruthlessly as an objective in war. The losses must be carried by the subsidiary enterprises, which is what gives to mixed farming its capacity to absorb shocks and to be less in need of subsidies. However,

you must never allow one season to upset the equilibrium between labour and the land, otherwise it requires several seasons of profit to restore the balance.

After what I have said about farming to preserve the hereditament, I know you will have expected some reference to erosion. In conclusion I will give you my views for what they are worth. Land may suffer both structural and physical damage. Erosion is the most obvious manifestation of the former. I have seen bad erosion in Australia, and I came out to look for it carefully with a good deal of righteous indignation. I must confess that it is not as bad as I had expected. It is a sickening sight to see the fine soils of the Darling Downs across the road like snow-drifts after heavy rain, but it is my belief that Europe suffered equal structural damage when its forests were cleared, but that most of the scars have since healed. I think much of your gully erosion is in the process of self-healing. On the other hand you must expect to face the costs of contouring in the same way as Britain once faced costs with its water furrows. One day, too, you may lead water on to those slopes by terra-cotta pipes, just as Britain has led water away from them. Wind erosion, I think, is a more serious problem, because the scale on which shelter must be planted in this country is so enormous. Despite all this, I think you have less to fear from structural damage than the rest of the world has from physical damage by soil exhaustion. That is why the main purport of my remarks tonight about mixed farming have dealt with the problem of how to increase our supplies of food and clothing by more intensive farming of the twenty-inch *plus* rainfall areas. My remarks are not comment on the past, but a warning in advance, for when your problem will be Britain's problem of preventing soil exhaustion under closer settlement. Erosion is not really possible under mixed farming—it is the latter math of pastoralism.

Finally, I apologize for boring you with a good deal of history, but if an old country has anything to offer a new one, it is her experience. Australian agriculture is in a quite normal process of transition to closer settlement. All periods of transition in life are dangerous and they are only overcome by patience. In this respect it might help to preserve our sense of proportion if we faced up to the fact that most of the cream has been skimmed from the virgin land of Australia and that the residual endowment is fairly poor. Whatever man does with phosphates and other minerals, the real wealth of a country is originally determined by those tremendous cataclysms which gave us our soils, and which still make our atomic explosions seem like child's play.

In this respect Australia is an old country which the elements of time have already levelled out too flat and too dry. Her compensation is that her people are young. Britain is perhaps a more stable country, jacketed by sea and packed by cloud, a water-cooled engine that can idle sweetly, whereas Australia, by comparison, is an aero engine dependant on its air speed, its evaporation and heightened metabolism to maintain its equilibrium. The latter is perhaps more in keeping with the spirit of the age and perhaps the greatest challenge facing the white peoples of the earth.

The Seventh Report of the Rural Reconstruction Commission

RURAL AMENITIES.

The Rural Reconstruction Commission's report on Rural Amenities is the seventh of the series and the fifth to be published. The fifth and sixth reports have not yet been made available to the public. The report discusses farm housing, rural education, farm water supply, telephone services, health services, electrification and amenities in country towns.

In the opening paragraph of the introduction the Commission points out that recommendations have been made in previous reports concerning the location and organization of farm units in order to give efficient production. It is reassuring that the report should commence in this way for it is obvious that at least some of the " underprivileged " sections of our farm population are in that position because of faulty location or organization of their activities. To endeavour to extend amenities piecemeal without first taking steps to ensure the farmers concerned have reasonable prospects of success would be costly and futile. It would be a case of prescribing for effects rather than causes. Rectification of these faults would in itself do a great deal to ensure a better life for the people concerned.

However, the Commission points out that even with an efficiently organized agriculture, certain disabilities would still attach to farm life and the more remote a farm may be from a township the more pronounced would these disabilities be. The Commission considers that extension of amenities to these farmers should result in a more progressive rural community with less sense of frustration. " From this should emerge a farm population with a broader knowledge and a better background against which to see its own experiences. This change implies responsibilities which must be undertaken by individuals, by organizations and by governments. Just how the responsibilities might well be allocated will be discussed in some detail in this report."

The Commission briefly traces the development of this disparity between city and country living and shows how city dwellers have been much better situated to take advantage of the rapid progress made in the application of labour-saving devices in the home. The view is expressed that the development of higher living standards largely devolves on the woman and that good housing and the availability of labour saving devices with consequent relief from strain on the part of the housewife, is of paramount importance in the future of farming.

Rural housing is the subject of the second chapter in the Commission's report. Apart from evidence taken by the Commission, factual data concerning farm housing was meagre. A survey made in the Western Australian wheat belt covered a sample of 5,401 houses, but the information collected was not very comprehensive. The results of four other surveys were available, one in New South Wales and three in Victoria, embracing respectively 100, 151, 150 and 273 homes. Fairly complete data were obtained concerning size of house and various facilities associated with water supply and disposal, light, cool storage and sewage disposal. The Commission was convinced that, although many homes in cities and towns are unsatisfactory, the percentage which lacks the ordinary amenities, e.g. piped water supply, kitchen sink, bathing and laundry facilities, hot water service, electric light, refrigerator, septic tank, is certainly much higher in the country than in the city. Striking differences were found in the more closely settled irrigated, dried fruit areas, and those in farming districts where homes are more scattered.

Many rural dwellers insisted to the Commission that better houses would be built if their incomes were more stable. However, the Commission considered that other factors in addition to finance must be considered in advancing better housing in

the country. Knowledge of what constitutes good housing is necessary. The value of good planning, satisfactory lighting, ventilation and sanitation should be more widely appreciated.

Common deficiencies of farm houses are discussed at some length. Location and aspect are frequently at fault. Many houses have just grown haphazardly, often to the considerable detriment of lighting, ventilation and general convenience. Building materials vary widely according to the locality. Where timber is readily available most houses are weatherboard. Galvanized iron is popular because of its low cost, but has little to recommend it except perhaps in tropical regions. The Commission considers there is much need for research into the mechanization of the use of pisé and mud bricks.

Although important to health and comfort, fly wire is found in only a limited number of country homes. Storage space for perishable goods is often inadequate. Poor storage facilities result in much waste of perishable foods, unappetizing meals, gastric troubles, especially among young children, and the encouragement of vermin.

The Commission notes that many country homes have inadequate lighting and ventilation. Good natural light with ventilation sufficient to air the house thoroughly is essential in adequate housing; yet many country homes, hemmed in with low verandahs and equipped only with small windows, tend to be dark and badly ventilated. Artificial lighting is generally inadequate to allow the whole family to benefit without crowding into the lighted area.

Bathing and laundry facilities are below desirable minimum standards in large numbers of homes in country towns and on farms. The Commission is aware that an inadequate water supply often limits the provision of desirable utilities for kitchen, laundry and bath.

The disposal of waste is usually a problem, and sanitary systems on the majority of farms are primitive.

The Commission, in consultation with the Commonwealth Housing Commission, makes a series of suggestions regarding desirable minimum standards to which housing should conform. It is emphasized that so far little has been done in Australia in the study of and distribution of knowledge concerning materials, design and costs involved in farm housing.

In considering the financial aspect of farm housing the Commission draws attention to the fact that even where agricultural conditions are reasonably good, housing is apparently not given much consideration in the allocation of farm income or in the assessment of the value of a farm. The Commission considers that housing standards on farms could be improved if capital for reasonable improvements were available at relatively low rates of interest. As a means of stimulating improvements in farm housing the Commission feels it would be practicable to insist on minimum standards for the houses of employees or of tenants of farms which are let under lease, other than perpetual or other Crown leases. Similarly it would be practicable to ensure that any sale of a farm property would be invalid unless the new owner agreed to bring the houses on the property up to the minimum standard. The Commission considers that Government Departments, especially those of Education and Agriculture, should give more attention to the housing of their officers in country areas.

The need is emphasized for paying special attention to improving living conditions in hotter climates. Under such conditions adjustments of personal habits, such as diet, hours of work, and types of clothing are necessary and perhaps, most important of all, housing conditions.

The following recommendations are made by the Commission based on the above discussion:

(*a*) The promotion of satisfactory and improved standards of housing on farms should be adopted as a definite post-war national objective.

(*b*) This objective should be one of the functions of the State housing authorities.

(*c*) Lands Departments of the States should cooperate with the State housing authorities by making their field staffs available where required for inspectional or local contract duties.

(*d*) All new homes on farms, whether for owners, tenants, or employees, should conform at least to a minimum standard as laid down in paragraph 1447.

(*e*) Whenever a farm is leased or sold for working as a single farm unit, the attainment of a minimum standard of housing on the property should be a prerequisite to the validity of the transaction.

(*f*) The needs of rural housing should receive special attention from the Commonwealth Experimental Building Station and from State housing authorities.

(*g*) Research into the mechanization of pisé construction is desirable.

(*h*) Education in good housing should begin in the schools and a desire for better and more convenient homes should be stimulated by a modern system of teaching homecraft to girls and manual work to boys at the age of, say, twelve years.

(*i*) States should be encouraged to include in their extension services to farmers advice on the planning, building, renovation and equipment of homes to suit their various districts.

(*j*) States should ensure that their officers stationed in country districts are provided with houses and buildings which attain a suitable standard.

(*k*) State rural credit authorities should be asked to cooperate by adopting as principles of loan policy—

1. The maintenance of satisfactory standards of housing on properties on which loans are secured ; and
2. Where necessary, the extension of existing loans to enable existing houses to be replaced or improved to the requisite standard.

(*l*) Where farm-owners desirous of bringing the farm dwellings up to the requisite standard are unable to obtain the necessary accommodation because of existing mortgages and the reluctance of their mortgagees to extend accommodation, they should be encouraged to seek accommodation, and if necessary, financial reconstruction from the State rural credit authorities.

(*m*) Any subsidy towards the improvement of housing standards or the provision of new houses should apply equally to the country as to the cities.

(*n*) Mass production of efficient refrigerators, to be available to farm dwellers at a reasonable cost, should be considered by the appropriate authorities. If such utilities were available the incidence of gastric troubles, especially among children during summer months, would be reduced.

Although education is a State function, it is a subject which the Commonwealth Rural Reconstruction Commission could hardly ignore in the course of its investigations, for it is not too much to regard improvements in this field as an essential prerequisite for any permanent improvement in standards of rural living.

The Commission considers that adequate finance is the main factor limiting the provision of a better educational system in both country and city areas. It was found that some State Education Departments experience difficulty in obtaining the amounts necessary to effect essential improvements. On the other hand some of these departments do not appear ambitious in preparing plans for the future except along lines which seemed old fashioned to the Commission.

A widespread degree of dissatisfaction with the present educational system was found by the Commission. It concerned first the amount of teaching given to the children and second the curriculum which, in the general opinion, fails to create a desire for knowledge or to lay a sound basis for citizenship on an understanding of the countryside itself.

So far as pre-school education is concerned the Commission hopes that it will be possible to establish nurseries and kindergartens at every country centre where there are sufficient young children and where the parents desire such facilities.

The advantages and disadvantages of centralizing primary school education are discussed. After reviewing all the circumstances the Commission, while appreciating the loyalty and, at times, the devotion of parents to the small schools, has concluded that these schools should be discontinued wherever the children can be brought to a centre within reasonable travelling distance each day.

In discussing post-primary and secondary education the Commission insists that every child who has shown that he or she is worthy of education beyond the primary school, and whose parents consent, should have the opportunity of such education. This would involve a considerable increase in the number of children attending higher elementary schools, high schools and the like, together with arrange-

ments whereby board and lodging for the children could be provided and subsidized if necessary. The Commission considers that biological subjects, including nutrition, should be taught in all schools whether for boys or girls. In addition the greater part which women now take in modern affairs demands a course of training for girls as broad in its general scope as the course given to boys.

Timely comment is made concerning the movement of people from the land to the towns. The Commission feels it is important that the community realize that many children who are born in the country will ultimately find their life's work in the towns and cities. This fact is inescapable because the area of good land which would justify intensive use is relatively limited and the prospects are not favourable for a great expansion in the number of workers in the farming industry. It follows, therefore, that there should be opportunity for country children in the secondary stage of education to obtain a type of training which will fit them for the city life if they desire it.

In a short section on higher education the Commission, in discussing the extension of university facilities to country areas, warns against endeavouring to expand too far. It is considered unrealistic to suggest that Australia at its present stage of development can afford more than one efficient university in each State. Most Australian universities are already handicapped by lack of funds, and an increase in their number would merely aggravate the problem. Organization of a series of university colleges or of specially advanced schools at larger country centres is held to be more practicable.

The selection and training of school teachers comes in for some attention from the Commission, for it is seen that the success of any system of education depends as much on the personality and efficiency of its teachers as on any other factor. If teaching as a career is to attract the most desirable students, and if modern educational facilities are to be widely extended, the status of the calling must be raised to a level equal to that of other professions. This can only be achieved if remuneration is such as to enable the Education Departments to compete with other professions and commerce for the type of young man and young woman best fitted for the grave responsibilities of teaching. The Commission considers that a minimum of two years of training should be a prerequisite for any teaching appointment. Potential teachers should be chosen for their personality as well as for their academic qualifications.

The Commission points out that limited systems of adult education exist in all States, but few of these cater for the interests of the farming community. Most of these which do exist are utilized to a far greater extent by residents of country towns than by farmers. The operation of the extension services of State Departments of Agriculture was discussed in the Commission's Sixth Report and is not considered further in this section. Some attention is given to the provision of adult education facilities for women in farming areas. Australia's backwardness in this respect is noted. A foundation for this type of service exists in the Agricultural Bureaux of New South Wales and South Australia. The Commission considers that these organizations, combined with the Country Women's Association in all States, should become an effective medium for the distribution of information to women in the areas served.

The Commission suggests that the training of local leaders among the community needs some attention. The value of mobile educational units, preferably road units, is emphasized as an effective means of disseminating information on a wide variety of subjects.

At the conclusion of the discussion the Commission makes recommendations that the Commonwealth Government should ensure that information concerning the conditions of education in every State is available to it, not only through official reports, but also through the work of a small staff of efficient educational experts,

who would work not as inspectors, but as consultants with State educational authorities.

Chapter IV is devoted to a concise and informative discussion of farm water supplies. Water supply is considered as both a necessary amenity and an essential feature of farms on which livestock are kept in any numbers. Approximate requirements are set out at 25 gallons per person per day when water is used liberally in the house. Stock requirements are given as 8 gallons per head per day for horses and cattle and 1½ gallons per day for sheep.

Attention is drawn to the poverty of Australia's rainfall and the fact that in many areas, even where agriculture is practised, the rainfall is low and irregular. Only in the coastal highlands is rainfall plentiful, and in some places this is already being used and distributed in large quantities for city supplies and irrigation. The problem of water supply in each district varies in intensity with the rainfall, the possibility of obtaining catchments and building storages and of distributing the conserved water; alternatively it may be more or less satisfactorily solved on each individual property by independent action.

Some farms are able to enjoy the benefits of a reticulated water supply. However, the cost to the consumer is not inconsiderable; it is seldom cheap enough to be used for irrigation. Where water is delivered in open channels the task of putting a sufficient head on it to provide a domestic service must be carried out by the farmer.

On the majority of Australian farms independent arrangements have to be made to provide a water supply. This usually involves questions of the source of supply, the reliability of that source, the volume which is needed, the method of obtaining the necessary pressure for distribution, and the quality of the water obtained. In considering the sources of water supply the Commission gives figures for run-off from roofs under varying conditions of rainfall. Attention is drawn to the surprising fact that in some regions farm families live with meagre water supplies and yet in the wet season on the same farm water runs to waste through lack of extra storage.

Problems associated with the use of catchment areas are discussed. It is not always possible to find a suitable natural catchment that will give the required run-off. The prospect of a succession of dry seasons always has to be taken into account. The provision of adequate storage facilities to guard against this is frequently difficult or impossible. Evaporation losses may account for a large part of the water stored.

Wells and bores are usually more reliable than earthen tanks. Unfortunately the quality of the water is not always good, and if it is obtainable only at a considerable depth the cost of sinking the bore and equipping it may be more than the farmer can afford.

In the case of equipment for providing pressure for water distribution, i.e. a pumping device and either a pressure vessel or a raised tank, a capital expenditure of £100 may be necessary. The Commission takes the view that such expenditure should be regarded by settlement authorities or financial institutions as part of the equipment of a normal farm, and if the extra capital outlay for such purposes is regarded as too great for the farm to bear then the farm itself is unworthy of being created or supported financially.

In areas of lighter rainfall, wherever the land is settled for cereal farming and sheep raising the problem of farm water supply for both farmhouses and stock may become very difficult. In the wheat and sheep areas in the 18-10 inch rainfall zone it is most acute. In many areas it has been met by the provisions of State operated systems. The settlement of the Mallee and Wimmera in Victoria on a wheat and sheep basis has been dependent on a channel system, except in the limited districts where suitable water is obtainable from bores. In South Australia there are several piped systems, while the large Tod River scheme has been installed to serve a considerable area of the West Coast. In Western Australia limited areas are provided with piped supplies from the Goldfields scheme.

Proposals for a considerable extension of piped water services in the lower rainfall farming districts of Western Australia are described. The scheme is estimated to cost £9,340,000. The area concerned comprises 12 million acres and contains 32 towns and some 30,000 people. The Commission points out that if these areas and others like them are to be given a satisfactory water supply, the scheme must be a national one, because it seems unlikely that the State of Western Australia could bear the extra financial burden of its interest and sinking fund. The Commission is forced to the conclusion that the people of Australia must face the question as to how far they are prepared to shoulder some of the cost of giving this particular section of the community a better service.

After surveying the methods employed for financing water schemes in other States and noting with approval the general principles adopted in N.S.W., the Commission agrees that if water supplies are to be arranged on an effective basis for many country districts, it will be necessary for State or Commonwealth Government, or both, to assist in financing the ventures until such time as the population increases to an extent which makes it able to meet the charges. At the same time it is vital that the agricultural merits of a district are assured before large capital sums are used for development of this kind. It would be folly to devote much of the capital resources of the nation to any scheme in a district which had no prospect of promoting a stable agricultural system of increasing intensity.

On the basis of the discussion in this chapter, the Commission recommends that in view of the extreme importance of satisfactory water supplies both from the amenity point of view and also for stock-raising

(*a*) Rural finance authorities should pay special attention to requests for credits for improving water supplies to farm houses and farms, always provided that—
   1. where boring operations are contemplated competent geological advice has been obtained; and
   2. such technical assistance and equipment as is necessary for planning the supply, for boring, or other constructional work, is available.

(*b*) In districts where neither surface catchments nor boring are likely to give satisfactory supplies of water to a mixed farming area and where that area is in other respects suitable for such farming, a scheme for the pipe supply of water should be examined, and any such scheme should be eligible for consideration as a national work, in which the Commonwealth might participate, as has been the case in the Murray River development and the Morgan-Whyalla schemes.

Rural telephone services are briefly discussed in Chapter V of the Commission's report and recommendations are made to the effect that

(*a*) the Postmaster-General be asked to review the system of payment for installing telephone lines to new country subscribers so as to reduce the first cost of a new installation and make it possible for more farmers to afford the benefits of the telephone service.

(*b*) Consideration be given to a scheme whereby an intending farm subscriber can, during the war period, lodge with an appropriate authority a capital sum to cover the whole or part of the cost of a new line, such sum being given taxation concession and also giving the applicant a right to preferential consideration for an installation when materials are again available for such work.

Health services and standards of nutrition are dealt with in the sixth chapter of the Commission's report.

The Commission calls attention to the change in outlook which has occurred in the past fifty years. The health of the individual was once regarded as a personal matter; now most progressive nations take steps to look after the health and physical welfare of their people, particularly of those who are more or less underprivileged. If country people are to feel that their place in the national life is regarded as of equal importance to that of city populations, then action must be taken.

The Commission surveys existing difficulties with regard to medical attention, hospitals and ambulances. In many rural districts medical services are poorly developed. The cost of medical service is largely decided by the distance which the doctor has to travel to the individual patient. If country people are to be afforded

a service approaching that available to city folk. subsidies in some form or other are inevitable. In some areas government services are operating satisfactorily. The Commission is forced to the conclusion that there is an urgent need for a properly coordinated medical service for the countryside, and that such service will of necessity have to be subsidized in respect to practitioners, hospitals and ambulances. Until steps are taken in this direction, a grave disability suffered by members of the farming community will persist. A similar state of affairs exists with regard to maternity hospital accommodation, infant welfare work and school medical and dental services. A substantial increase in the subsidies for aerial medical facilities is required if the service is to extend and to be maintained at a high standard.

In discussing standards of nutrition the Commission refers to the rarity of Australian surveys of the standard of health and development of country populations. What evidence there is available indicates that it would be unwise to assume the health of country communities will be good mainly because they live in the country. It is likely that there are numerous districts in Australia in which special deficiencies of local foods will be found to occur and in which special nutritional problems caused by natural features of the countryside exist. The difficulty and cost of obtaining in some country areas certain types of food which are highly desirable or essential, and which are readily available to city populations, requires emphasis. Milk, fruit and fresh vegetables are the special foods concerned and problems peculiar to the supply of each of them are discussed by the Commission.

Arising out of the discussion in this chapter the Commission makes the following recommendations :

(*a*) *Medical Services in Country Areas.*
1. Recognizing that there is an urgent need for a properly coordinated medical service for country areas, the Commission recommends that such service be organized to cover practitioners, hospitals and ambulances.
2. The Commission recommends that strong local committees be encouraged to take an active interest in the local hospitals and to provide extra amenities above the minimum basic standard.

(*b*) *Maternity Hospitals.* That the appropriate authorities give attention to the following needs :
1. An increase in the number of maternity beds in public hospitals ;
2. some kind of hostel accommodation where the expectant mother may wait within easy reach of the hospital immediately before her admittance ;
3. an adequate system of home help, subsidized if necessary, for families which need assistance and cannot afford a reasonable wage for the help provided.

(*c*) *Infant Welfare.*
1. The extension of infant welfare and baby health facilities in rural areas and the provision by local governing authorities of well-planned and adequate buildings for the service ;
2. that the appropriate authorities investigate the need for an extension of mobile baby health centre for work in districts where centres are few and small.

(*d*) *School Medical Services.*
1. That school medical services be staffed on a scale sufficient to provide biennial medical and annual dental examination for all school children ;
2. that in cases where children need treatment, arrangements be made for collaboration between school medical inspectors and the local medical officers referred to in (*a*) above.

(*e*) *Aerial Medical Service.*
1. That this service be extended for the benefit of distant rural settlement ;
2. that a substantial increase be made in the present Commonwealth subsidy for the extension and maintenance of this service at a high standard ;
3. that aerial ambulance services be developed in more closely settled districts.

(*f*) *Nutritional Standards in the Country.*
1. Local governing authorities in each district be urged to face the problem of ensuring adequate milk supplies in their districts ;
2. State agricultural departments should use their valuable experience in vegetable growing gained during the war as a basis for stimulating vegetable production for local consumption in suitable districts ;
3. railway authorities should be encouraged to give more attention to the provision of a service of refrigerated cars ;
4. local authorities should be encouraged to take an interest in the availability in their districts of refrigerated space in which temporary supplies of vegetables and fruit can be held during the hot season of the year ;

5. wider school training in domestic science should be provided for country girls with special reference to nutrition, and trained home economists should be appointed as extension officers in State Departments of Agriculture.

Problems of rural electrification are dealt with in Chapter VII of the Commission's report. It is with respect to electricity supplies that country folk are at the greatest disadvantage as compared to city dwellers. Most rural areas of Australia suffer from this disability. The extent of electrification in country districts varies widely from State to State. In Tasmania more than 80 per cent. of rural homes are supplied with electricity. In Victoria some 10,000 farms are connected to existing services. A number of country districts in the south-west are supplied and some spread of mains supplies from the larger towns is taking place in Queensland. In South Australia and Western Australia the distribution of electricity into farming areas is at present small.

After examining uses for electricity in the home and on the farm estimating approximate rates of power consumption for various household operations and calculating costs at three different levels—2*d*., 6*d*. and 1*s*. per unit—the Commission concludes that the majority of agricultural enterprises will not be able to afford 1*s*. per unit for the current which they use. The only hope of a general expansion of electrical developments in the main farming districts must therefore depend on the extension of the supply mains of large generating schemes. Estimates of costs of using electricity for various farming operations are tabulated and constitute an interesting section of the Commission's analysis.

The need for coordination in bulk generation of current is emphasized. It is considered unlikely that private enterprise will find the extension of electricity into farming areas sufficiently attractive to warrant its entry into the field. It is concluded that economical distribution of current at a price within reach of the average farmer will not be achieved except through a widespread scheme operated by the State or through State created instrumentalities. The extension of electricity into a greater number of farming districts must be a national matter and will not readily grow from many locally governed organizations.

Problems of distribution are considered in some detail and some popular misconceptions regarding the economics of the generation and distribution of electricity are corrected. Consideration is given to the guarantees necessary for financing extensions of electrification.

With regard to charges for electric current the correct principle would seem to be that if the nation adopts the idea of making life more attractive for farmers in country districts by enabling them to get their supplies of electric current more cheaply, this should be done by direct developmental grant from the Treasury rather than by raising the cost of an essential industrial commodity, such as electricity, to all other consumers.

The Commission realizes that high prices for electrical appliances and fittings must retard the spread of electrification. In Australia mass production of such equipment must be ensured if the prices are to be kept at a low level.

The Commission's recommendations regarding rural electrification are as follow :

1. That the Commonwealth should from time to time invite the governments of the States to nominate representatives to conferences on electrical standardization ;
2. that the Commonwealth should encourage the States to extend rural electrification as circumstances permit in regions where settlement is permanent in character and especially in those which are closely settled.
3. In order to facilitate the installation of electricity on farms the State Rural Finance Authorities should be prepared to provide such credits as are necessary to enable farmers to install electricity and reasonable electrical equipment on their farms, always provided that
   (*a*) the farms concerned are efficient in size ; and
   (*b*) the system of farming carried on is satisfactory and stable.

A scheme of this kind would have obvious advantages over the present position

in which the hire-purchase principle is often the only assistance which the farmer can obtain.

The final chapter of the Commission's report discusses the country town and its functions. Country towns are often centres for sales of livestock and many other forms of produce, on the one hand, and on the other, centres where farmers make many purchases or carry on their financial, legal and other transactions. Many amenities such as schools, medical services and most amusements and recreations are necessarily concentrated at these places. In addition the country town itself is a centre for the consumption of farm produce and when it is large enough and the trade is developed, it can absorb a substantial proportion of the district's production.

Information about many aspects of Australian country towns is meagre. The Commission supplemented its own observations with information collected by Mr. and Mrs. A. J. McIntyre during their survey of 180 Victorian country towns.

The origin and evolution of Australian country towns is surveyed briefly and their economic activities described. The effect of fast road and rail transport in concentrating activities in fewer larger centres is noted and some pertinent observations are made concerning decentralization. "While such decentralization is a matter for consideration by those who have special knowledge of those industries, this Commission takes the opportunity of recording certain aspects of the subject presented to it in evidence. It does so because it is well aware of the pressure which will be exerted on responsible persons by local bodies or prominent individuals to obtain preference for schemes which would give them advantage, irrespective of the ultimate fate of the projects. Pandering to such proposals can have disastrous effects. When once the artificial support which originated it ceases, the factory or works often finds normal competition too severe and the project fails; those who put their money into the venture lose it and, worse, the extra prosperity which the centre enjoyed during the period of activity and which encouraged all sorts of developments disappears, leaving the town more dishevelled and less useful than it was before the episode began. *On the other hand, where satisfactory conditions for both industry and those who work in it can be established in a country centre, the advantages to both industry and the district are considerable;* further, the increased establishment of industries in country districts would diminish the rate at which city problems such as human transport, distribution of goods, traffic, and water supply assume menacing proportions."

Country town amenities—water supply, electricity, sewerage, drainage and housing—are discussed and reference made to the improvement in the general activities of country towns which can be effected by better housing and some degree of planning. Suggestions are made for the respective roles to be assumed by the Government and the local community in providing district amenities.

The Commission also gives attention to the improvement of country library facilities and the provision of community centres.

As a result of the discussion in this chapter the Commission recommends:

(*a*) That the guiding principles which it has enumerated for the establishment of secondary industries should be observed.

(*b*) That wherever there is reason to anticipate that a country centre can be expected to expand, every effort should be made to ensure that it obtains

1. an adequate and reliable supply of good water;
2. an efficient sewerage system;
3. an effective supply of electricity;
4. satisfactory drainage;
5. a progressive housing scheme;
6. advice on town planning, backed with such legal powers as are necessary;
7. a community centre or centres with all or some of the activities set out in paragraphs 1671 and 1672;
8. any other special amenities, the ready development of which may be facilitated by special local circumstances, e.g. attractive river frontage, botanic gardens, etc.

In making these recommendations the Commission is well aware that successful development will only occur at such centres where both a progressive community

spirit and sound leadership develop among the local citizens. These cannot be bought but they can be stimulated by a sound system of education and by ensuring a wider dissemination of literature on appropriate subjects.

In an afterword the Commission admits that many of the improvements recommended in the report are matters for action by the State Governments rather than by the Commonwealth, but that the people of Australia as a whole have a very definite interest in the welfare of their country populations and the standard of amenity which they are able to enjoy.

It is considered that a definite case for Government action in assisting in the provision of farm amenities is made through the Australian tariff policy, which has raised the farmer's costs, reduced his profit margin and so diminished his capacity to provide amenities for himself.

The report concludes with a suggestion for establishing, in any of the fields of improvement discussed in the report, a small expert Commonwealth advisory body to discuss the problems concerned with the State authorities, to devise ways and means in which the Commonwealth can aid in satisfactory development, and finally to observe the results of any grants which have been made.

The Commission has dealt with a variety of subjects and presented an extraordinary amount of factual information in the 92 pages of its report. It is informative, stimulating and comprehensive, though, in this last respect, it is rather curious that it should contain no discussion of the motor car and the radio as farm amenities, yet telephone services find a place. The report maintains the high standard set by its predecessors and should have a wide circulation among that section of the community interested in Australian rural problems.

(Received for publication, 9th September, 1946.)

R. P. Roberts.

Farrer Oration 1946*

By
H. Wenholz,
Deputy Chief, Division of Plant Industry, Department of Agriculture, N.S.W.

Although it is 60 years now since William Farrer began his epoch-making experiments with wheat on his property at Lambrigg, there is no sign of any year passing without constant reminders of his work, and a realization of its tremendous national value.

It is impossible to conceive that in this year of 1946 two events of great potential importance, viz. the projected establishment of a Wheat Research Institute in N.S.W., and the holding of an Australian Conference on Wheat Breeding, would be taking place if Farrer had not lighted a beacon which still continues brightly to illustrate the value of wheat breeding research and to illuminate the field of endeavour.

Previous Farrer orations have dealt rather exhaustively with the methods and achievements of this, probably the greatest of Australian benefactors, although repetition of reference to these aspects can never be made too often. This contribution will, however, essay to indicate directions in which further wheat research needs to be developed with the ultimate object of securing further improvement in some phases of the industry.

In common with much other agricultural research conducted in Australia during the war, wheat breeding research suffered very greatly. Practically the

* Delivered at the N.S.W. Agricultural Bureau Conference, Hawkesbury Agricultural College, 17th July, 1946.

whole work of the N.S.W. Department of Agriculture in wheat breeding and investigational work had to remain in abeyance during the period owing to the enlistment of almost the entire staff engaged in this work. It was left to the Sydney University to carry on with its breeding work to produce stem rust resistant wheats.

One of the greatest conceptions in the solution of the rust problem which is still concerning us today as it was in Farrer's time was that it would be overcome by breeding resistant varieties. Sixty years ago when wheat growing in N.S.W. was largely confined to the Slopes and Tablelands, wet or humid conditions favouring the development of stem rust so reduced the total production that they nearly brought about a national disaster. Several Rust-in-Wheat Conferences with Australian-wide representation were held and it is amusing today to read in the reports of these conferences that some of the foremost practical agriculturists of the time seriously advocated dressing the land with common salt to prevent or mitigate the development of the scourge. Farrer alone advanced the conception that rust in wheat would be overcome by breeding resistant varieties. The newspapers of the day strongly attacked such an idea, but Farrer was able at least to demonstrate a great inherent difference in rust resistance between varieties of wheat, and to produce some varieties which had, under some conditions, a measure of practical resistance.

His greatest practical achievement in this direction was, however, derived from his observation that early maturity in wheats enabled them largely to escape stem rust. The early maturing varieties which he produced were not the best suited to the Tablelands and cooler parts of the Slopes, but they at once made possible the extension of the wheat belt of N.S.W. to hotter and drier districts. Even before the end of his life, Farrer was able to see the area of wheat in N.S.W. double itself through this development, and had he lived another seven or eight years he would have had gratification of seeing the original area quadrupled.

Although some improvement was effected in the rust situation in the more favoured rainfall districts, the problem largely remained in these districts in that late maturing wheats which yielded very well in these districts in normal seasons could never be grown without risk of loss in unusually wet seasons.

In the North-west, with its relatively high temperatures and humidity combined, the most favourable conditions for the development of stem rust exist and early maturing rust-escaping varieties are of no avail in some seasons. There the solution of the problem becomes entirely a matter of inherent resistance in the variety.

No Australian varieties of wheat were found to possess high resistance to stem rust under these conditions, and this part of the State remained subject to severe losses in epidemic years. Little or no progress was made in breeding rust resistant varieties of wheat suited to this region until varieties of high resistance were introduced from other countries. Dr. Waterhouse, of Sydney University, used as resistant parents the American varieties Hope and Webster and produced Hofed and Fedweb, but although these varieties had the necessary resistance to stem rust, they do not meet other requirements for a suitable variety and they are not likely to be largely grown. The Department of Agriculture then set about combing the world for rust resistant wheats and obtained some Hope and Pentad Crossbreds from U.S.A. and Canada, and some unnamed crossbreds from Kenya Colony, Africa, as well as some wheats, including Gaza, from Palestine.

It is this foresight and endeavour which is responsible for our being in such a good situation today in N.S.W. in the work of breeding of rust resistant wheats.

Dr. Macindoe of the Department of Agriculture used one of the Kenya wheats to produce Eureka and this variety rapidly became popular for a few years until it suddenly lost its high resistance to stem rust under certain environmental conditions of which the North-western wheat belt is capable. Biologists explain this loss of resistance as being due to the development of a new physiologic race of rust.

During post-graduate studies in America Dr. Macindoe found that another of the Kenya wheats had different resistance from the one he had used in producing

Eureka. Fortunately he had used this wheat to produce the more recent varieties Charter and Yalta. These wheats have proved highly resistant to stem rust under all field conditions. Dr. Waterhouse also used one of these Kenya wheats to produce the resistant variety Kendee.

Meanwhile Dr. Waterhouse also produced the variety Gabo, using the variety Gaza from Palestine as the resistant parent. Using a strain known as Double Cross obtained from America as a parent, Dr. Macindoe has recently produced the variety Celebration, which has also entered field trials.

So far these newer varieties, viz. Gabo and Kendee of Waterhouse and Yalta, Charter and Celebration of Macindoe, have proved under all conditions in the field to be highly resistant to stem rust, and as they yield well and have other good qualities they will be rapidly increased and grown in the North-west. They may also prove suitable for other parts of the State.

It has been shown that there are different fundamental reasons for the resistance to stem rust of certain varieties, and in the end success in breeding permanently resistant varieties may depend on effecting a combination of different kinds of resistance in an Australian variety.

New species of wheat allied to the common bread wheat such as *Triticum timopheevi* have been introduced from Russia by the Department. This species has been found to have high resistance to many diseases including stem rust. It has already been crossed successfully by Mr. Pridham with some Australian varieties, and some good material may be developed from these crosses.

Discussion on the proposed establishment of a Wheat Research Institute has been brought about by a long-felt dissatisfaction of millers and bakers with the general milling and baking qualities of N.S.W. wheat. These were aspects of wheat improvement which Farrer pioneered, and from the complaints of millers and bakers today it might appear that little progress has been effected in the last 50 or 60 years in these qualities in the wheat produced in this State. As far as the milling quality is concerned, that may indeed be to some extent the case.

Good milling quality largely depends on the ability of the wheat to produce a high percentage of flour of good colour. In the early days when wheat growing was largely confined to relatively cool districts, a well filled plump grain with a high percentage of soft starch was produced (when rust was not present), and such grain was of excellent milling quality. When Farrer extended the wheat belt of N.S.W. into hotter and drier districts, however, it was inevitable that there would be some lowering of the milling quality of grain produced under these conditions. The variety Federation was inherently good in its capacity to fill a plump grain, if it obtained any sort of an opportunity to do so. It might have been expected, however, that the relatively low soil moisture and the rapid ripening conditions of the hot western climate were too unfavourable to allow that translocation and prolonged deposition of soft starch in the grain necessary to fill a plump berry which occurs under cool slow ripening conditions with abundant soil moisture. This does not mean, however, that the handicap of environment on milling quality cannot be overcome, in some measure, through the development of a better inherent ability in the variety to fill its grain under such conditions. The fact that Nabawa is superior to Bencubbin in this respect inspires hope for some progress by breeding.

Baking quality in wheat is such a very complex character that there will always be room for improvement and research in this field. Reduced as far as possible to simple practical terms, it may be said to depend largely on the quantity and quality of the gluten in the wheat. Since it is essential that the significance of these factors be fully appreciated in any approach to wheat research some recapitulation of existing knowledge in this regard may not be out of place here.

While cool slow ripening conditions are favourable for the plump filling of the grain, they are also conducive to the development of soft starch and low gluten content. Quick ripening conditions, on the other hand, promote a relatively high

gluten content, but such conditions are against good filling of the grain. Thus good milling quality and good baking quality are to some extent incompatible. Although nature is not easily circumvented, there is no reason why research should not make an effort to improve on her design.

Our present knowledge is that climatic conditions appear to be the most potent in determining the so-called flour strength or baking quality of wheat in so far as the gluten content is concerned, but certain soil fertility factors are also influential in this regard. Gluten content is closely related to nitrogen content and the nitrogen intake of the wheat plant has therefore an important bearing on the gluten content of the grain. In its turn the nitrogen intake of the wheat crop is largely dependent on the nitrogen content of the soil. It is a very little known fact that superphosphate has an adverse effect on the nitrogen or gluten content of the grain, but who would be so bold as to suggest that southern wheat growers should dispense with superphosphate. Much more research on the influence of the soil fertility factors on wheat quality is required.

Taking all these factors into consideration, it is suggested that southern N.S.W. wheat will always have a strong general tendency to be of relatively good quality and that we must look to the relatively quick ripening conditions of northern and western N.S.W., particularly to the rich high nitrogen soils of the north-west, for wheat of high baking quality.

It has been indicated that baking quality in wheat is also influenced by another important factor, viz. the quality of the gluten. This character is considered, on present knowledge, to be more largely heritable than influenced by environment. But we are still much in the dark on many aspects of this question and much investigational work will have to be undertaken before accurate knowledge will be available as to the exact relative influence of heredity and environment on the gluten quality of wheat as well as on the relative importance of heritable and environmental factors in determining the total baking quality as represented by quantity and quality of gluten in wheat.

At the present time there is a very strong inclination for millers and bakers to regard the matter of improving southern wheat, where there is a strong natural environmental influence in keeping the gluten content at a low figure, as a simple matter for the plant breeder. No marked improvement against such forces of nature has been effected in any part of the world. Most attempts in this direction in N.S.W. have resulted in the production of mottled grain, which is largely nature's manifestation of her strong influence in reducing the gluten content of a naturally hard wheat to the approximate content of a soft wheat environment. It is understood that such a mixture of horny and soft endosperm in the same grain causes much trouble to millers in conditioning the wheat for milling, and that they would prefer to have the wheat grain uniform in this regard.

Whatever research is undertaken in a soft wheat climate in endeavours to determine the relative influence of heredity and environment on the quality of wheat, it seems that the most practical results in evolving varieties of wheat suitable for the large section of country in which hard wheat of relatively high gluten content can be produced will be achieved by breeding work conducted under these conditions. It is a matter for regret that the funds available today for wheat research are appallingly low by comparison with those spent on research in other agricultural industries in Australia, such as wool, dairying, sugar, fruit, etc., although the dividends already yielded from such investment have been truly remarkable. Research is indivisible, but the greatest dividends will be paid from wheat research carried out along lines and under conditions in which there is most hope for substantial improvement and in which the results obtained are likely to have a wide practical application.

It may appear to some that stem rust and wheat quality are the only important fields necessary or desirable in wheat breeding research in N.S.W. or in Australia

today. Flag smut is not now a serious problem, and the part played by plant breeders in saving Australia from a national disaster in the control of this disease may not be fully realized. Bunt, loose smut, septoria leaf spot, foot rots, and cold injury are still capable of taking a severe toll of wheat crops, and all these troubles may eventually be eliminated by the production of resistant varieties.

The greatest original contribution in wheat breeding which has occurred in Australia since the days of Farrer is considered to be that made by Dr. Macindoe in the breeding of wheats of "winter" habit. Briefly, a wheat of this type under Australian conditions is one which can be sown as early as desired in autumn and which will not make any attempt to head until it has experienced a definite amount of low winter temperatures. It is not difficult to visualize the high value such a variety would have in those districts, especially in the north-western part of N.S.W., where favourable early autumn rains sometimes occur and where sowing of the present varieties cannot be made because of the risk of their heading before or during the winter, with serious loss from frost damage.

The Department of Agriculture has been forced to undertake its wheat breeding work to produce stem rust resistant and winter type wheats of high baking quality particularly suitable for north-western conditions under the very great handicap of having no experiment farm in this region. This is the only part of the State with peculiar conditions of climate and soil differing so remarkably from the conditions obtaining in other parts of the wheat belt that it is considered that a large allocation of any funds obtained for wheat research must be made to enable the Department to establish a research station in this region in order to undertake breeding and other investigations in wheat production.

This part of the wheat belt of N.S.W. lends itself to large-scale economic production of high quality wheat. This wheat will make up for any natural quality deficiencies of southern wheat, and when home requirements of strong wheats are met, as they will easily be, this production may be of very considerable economic importance in catering for the growing demand in export markets for a higher baking quality in Australian wheat.

If well provided for and expertly guided, there is every reason to believe that during the next decade or two wheat breeding research will produce results of remarkably great national value in Australia as it has done in the past.

It is hoped that this contribution of thought will serve in some way to perpetuate the memory of William Farrer by indicating the foundation on which wheat breeding work in Australia is based, and, also, by indicating some of the needs, to provide some encouragement and inspiration for future wheat breeding research in this continent.

The Organisation of Soil Conservation Work in South Australia

By
R. I. Herriot,
Soil Conservator, Department of Agriculture, S.A.

With the growing interest in soil conservation throughout Australia, most of the States and the Commonwealth have taken steps towards the development of some special service to grapple with the problem.

New South Wales has developed a Soil Conservation Service as a separate Department responsible to the Minister of Conservation, who also handles Forestry and Water Conservation. Victoria has set up a Soil Conservation Board composed of representatives of various interested Government Departments in addition to

two representatives of the farming community. South Australia has a double-headed organization consisting of an Advisory Committee on Soil Conservation and a Soil Conservation Branch within the Department of Agriculture. Western Australia has apparently decided to set up a somewhat similar organization, and the Commonwealth has established a Soil Conservation Service for Commonwealth Territories within the Department of Interior. There is, as yet, no indication of the type of Service or its Departmental affiliation that will develop in either Queensland or Tasmania.

It is proposed to coordinate the activities of these various organizations through the Standing Committee on Soil Conservation which will report, as does the Standing Committee on Agriculture, to the Agricultural Council.

Three States only, New South Wales, Victoria and South Australia, have made substantial progress with the organization of their Soil Conservation work, and it is interesting to note that each has decided to work an entirely different type of organization. It is unwise, however, to attempt to compare these different types of organization with a view to pronouncing the ideal set-up, for all organizations are young and have experienced varying degrees of political support. The important thing is to get the job done, and until an organization has shown that it cannot do this, then it must be regarded as satisfactory.

As stated above, South Australia has a double-headed organization. The Advisory Committee on Soil Conservation is constituted in much the same way as the Victorian Soil Conservation Board, with the exception that it is charged solely with the responsibility of advising the Minister on matters pertaining to soil conservation. It is concerned only with policy, but serves as a valuable medium for inter-departmental coordination.

The general administration of soil conservation work in South Australia is undertaken by the Soil Conservation Branch of the Department of Agriculture, with the Soil Conservator as its senior officer. In addition, there are four Assistant Soil Conservators, one Soil Conservation Engineer and two field officers. Clerical work is handled by the Clerical Branch of the Department of Agriculture.

The first appointment to the Branch was made over five years ago, but most of the expansion has occurred during the last twelve months. With the rapidly increasing numbers of landholders making enquiries for special assistance, there is every indication that the present staff will soon be totally inadequate to handle both this aspect and also the general educational work. In order to assure future sources of personnel, a system of cadetships has been inaugurated by the Department, and at present there are six cadets doing the agricultural science course at the University of Adelaide.

The Soil Conservation Branch as at present constituted has a very wide function, for in addition to attending to the general questions of education, research and administration as laid out in the Soil Conservation Act, it is also a Service Department.

In South Australia it is expected that the farmer will do everything in his power not only to prevent erosion of his property, but also to handle existing problems. Sections 13*b* to 13*o* of the Soil Conservation Act 1939-45 lay down this responsibility in no uncertain terms, as any occupier who fails in this regard may find himself answering a charge for a Soil Conservation Order taken up at the instigation of the owner (if he is a tenant), the mortgagee, the neighbour, the local committee or the Minister.

It is recognized, however, that the farmer needs technical assistance if he is to fulfil adequately the obligations imposed in this far-reaching legislation. In this regard it has become general policy in South Australia to provide such assistance where any farmer has exhibited a willingness to help himself. The Soil Conservation Branch attempts to do all those things for the farmer that he cannot reasonably do for himself. This service, which is of course free, usually takes the form of technical assistance for the survey and planning of such engineering structures as contour banks

(terraces), dams, etc., and the preparation of contour plans for new orchards. In addition, special machinery required such as graders for contour banking or ploughs for contour furrowing are provided on hire at a nominal cost.

Provision is also made for meeting the financial problems of the farmer in carrying out these obligations. Section 11 of the Soil Conservation Act empowers the Minister to make loans or grants of money to settlers for approved soil conservation works upon such security and conditions in respect to interest rates and repayments as he cares to stipulate. A special fund, supplied from the general revenue of the State, has been established for this purpose, and it has proved a most valuable adjunct to the general service.

Conditions in respect to interest rates and repayments are, of course, varied to meet each particular case. As a general principle, fully productive works are expected to pay normal interest rates (4 per cent.), whilst works which are protective only are financed interest free. Until now, grants have been made only where works are undertaken for the protection of some public utility.

In order to get at danger spots before trouble arises, the Soil Conservation Act also requires that " a person shall not clear or commence to clear any scrub land unless he has first given the Soil Conservator three months' notice in writing of his intention to do so ". When this legislation is coupled with that dealing with Soil Conservation Orders there is adequate provision to require any person to refrain from clearing, if as a result of such clearing " that land or any other land " is likely to be injured. It is admitted that most usable land in this State has already been cleared, and to that extent the legislation cannot have any material effect, but it will still prove a valuable weapon in controlling the urge to development that is at present operating in some dangerous portions of the country.

Recent amendments to the Soil Conservation Act also provide for the establishment of Soil Conservation Districts. This move is aimed at bringing the farmers more closely into the organization of soil conservation work in this State. Districts can only be established upon the receipt of a petition favouring such a move, signed by 60 per cent. of the occupiers of land within the area. So far no such Districts have been established, but preliminary steps have been taken in several areas. Modelled upon the general idea of the Soil Conservation Districts in America, it is expected that they will eventually play an important part in the organization of soil conservation work in this State.

With such a liberal policy in respect to Services it is obvious that problems of personnel are not the least of those experienced by the Soil Conservation Branch. Under the circumstances certain functions that obviously belong to the Soil Conservation Branch, such as research work, are not as yet receiving any special attention. Plans exist for the establishment of field stations, at which it is hoped to combine the forces of the Waite Agricultural Research Institute, the Council for Scientific and Industrial Research and the Department of Agriculture, but at the moment the extension of existing knowledge and service fully occupies the resources of the Branch. When it is felt that existing knowledge is reaching the farmers and their demands for service are being adequately met, Research will receive the attention that is due to it.

Æolianite and Soil Formation in Western Australia

By
L. J. H. Teakle,
Department of Agriculture, Western Australia.

In his excellent and thought-provoking paper "Post-Miocene Climatic and Geologic History and Its Significance in Relation to the Genesis of the Major Soil Types of South Australia", Crocker (1946[1]) presents a wealth of detail supporting a theory which offers a convincing explanation of the heavy accumulation of calcareous material in certain South Australian soils. It is suggested that calcium carbonate in these soils is derived largely from calcareous loessial material blown inland as a result of the winnowing of the coastal sand-dunes or Æolianite. These dunes are highly calcareous and it is suggested that they are derived from material blown from the surface of the continental shelf exposed by the fall of the sea during the Pleistocene glacial periods. These dunes have now consolidated and are generally fixed by a vegetative cover.

In the course of the formation of these dunes, it is considered that wind, in a winnowing action, removed fine, highly calcareous material which was carried further inland and deposited. The accession of calcium carbonate which resulted is thought to account for much of the travertine in the solonized brown soils and related soils of South Australia. Other outside sources, such as cyclic salts, are calculated to be of very minor importance.

The position appears to be quite different in Western Australia, where the solonized brown soils occupy approximately 70 million acres. Æolianite, similar in formation and composition to that described by Crocker in South Australia, occurs extensively along the west and south coasts, but its influence appears to extend but a few miles inland.

A study of the succession of soils as one proceeds inland from the coast affords no evidence to the support of the theory under Western Australian conditions. The pattern of soils and the close relationship between soil type and the underlying rock in the red-brown earth zone and, also, in the solonized brown soil zone in the lower rainfall areas inland, are certainly not suggestive of the accession of wind-borne, calcareous dust derived from the coastal Æolianite. Again, the sharp break between the alkaline solonized brown soils in Western Australia and the so-called desert loams described by Prescott,[2] which in spite of the arid conditions are generally acidic in reaction, affords no support for any theory based on broad scale wind deposition of calcareous material winnowed from the coastal Æolianite or other source. Observations suggest that the influence of wind-borne, calcareous material in Western Australia is limited to the marginal soil types in the vicinity of certain salt lake systems which traverse much of the south-western agricultural and pastoral areas.

It seems unnecessary to postulate the accretion of material from outside sources to account for the liberal amounts of calcium carbonate in the solonized brown soils of Western Australia. There is no reason to believe that the substantial accumulation in the subsoil is not the result of simple pedogenic processes involving chiefly the parent material, the leaching factor of the rainfall, and the circulation of minerals by the vegetation.

The vegetation factor in the accretion of minerals in the surface layers of the soil is dismissed by Crocker (p. 32) as of very minor importance. Pedologists in Europe and America have drawn attention to the greatly enhanced surface accumulation of bases, particularly lime, under deciduous as compared with coniferous forest on parent material apparently identical.

The complex soil pattern observed in certain parts of the Salmon Gums soil survey in Western Australia, which is in the solonized brown soil zone, is at least suggestive of the probable importance of the vegetation factor in soil formation. In this soil complex, where all field evidence points to the relative uniformity of the parent material, the pattern involves small patches of the Beete sandy loam pock-marking the Circle Valley sand. The surface of the Beete soil is highly calcareous and contrasts with that of the Circle Valley which is solonetzic in nature and has a few inches of a leached sand on a sandy clay subsoil in which calcium carbonate accumulation does not become evident until a depth of 12-20 inches is reached. In both soils the calcium carbonate accumulation is limited to a depth of several feet. In one comparison, where these two soil types in the complex were examined at points one chain apart, no calcium carbonate was observed below 3-4 feet. The underlying clay at both sites to a depth of 12 feet appeared similar in colour and texture. The only obvious factor associated with the outstanding difference in the surface characters of these soils was the vegetation. The characteristic Eucalyptus species of the calcareous Beete soil were *Eucalyptus oleosa* and *E. conglobata* ; the dominant species on the Circle Valley sand were *E. eremophila*, *E. dumosa*, *E. Flocktoniæ* and *E. gracilis*.

While the work carried out to date does not establish the vegetative factor as the agent responsible for the differentiation of these soils, the observations suggest that it is important and merits much greater quantitative attention in the study of pedogenesis than has commonly been accorded it in the past.

References.

1. Crocker, R. L. : Coun. Sci. Ind. Res. (Aust.) Bull. 193, 1946.
2. Prescott, J. A. : Coun. Sci. Ind. Res. (Aust.) Bull. 177, 1944.

(Received for publication, 15th July, 1946.)

Tests with Benzene Hexachloride and D.D.T. Incorporated in the Soil for the Protection of Crop Plants from Black Beetle

By
C. R. Wallace,
Entomology Branch, Department of Agriculture, Sydney, N.S.W.

Soil-dwelling adults of the Dynastid *Heteronychus sanctæ-helenæ* Blanch. cause great damage to various field crops, pasture grasses and vegetable crops in coastal New South Wales. The following is an account of certain field tests in the Berry-Nowra area during the period November, 1945 to May, 1946.

The aim of the tests was to develop methods of protecting plants from black beetle by growing them in soil impregnated with dusts containing 666 or D.D.T.

In this paper the symbol 666 is used to denote benzene hexachloride (all isomers) while the letters D.D.T. are used to indicate dichloro-diphenyl-trichlorethane (all isomers). For further brevity the nature of each dust used is only briefly indicated in the text together with a serial number ; these serial numbers relate to Table 4, in which the detailed constitution of each dust is given.

These tests are concerned not only with insecticidal effects but also with chemical effects upon plants ; therefore the composition of each dust is indicated in the text by its percentage of 666 or D.D.T. (total isomers). The content of insecticidally active isomers can be seen in Table 4 or can be derived from the following information : (i) all 666 incorporated in these dusts contained 13 per cent. of the γ isomer ; (ii) the

D.D.T. taken up on superphosphate contained only 50 per cent. of the p, p-isomer.; (iii) with one exception* all other dusts containing D.D.T. were made with a high grade of the insecticide comprising 95 to 100 per cent. of p, p-isomer.

Series I. Dusts Applied in Narrow Strips by Hand.

Field experiments[1, 2] early in 1945 had demonstrated that D.D.T. dust stirred into the soil protected high-value market garden crops from the pest. A series of pot tests in September-November, 1945, had shown (*a*) that 666 was very much more toxic to black beetle than D.D.T., and (*b*) that 666 at certain low concentrations in the soil was harmful to the growth of maize.

With the results of the pot tests as a guide, a field experiment was commenced at Berry in mid-November to explore the possibility of growing field crops in narrow strips of soil impregnated with insecticide. With the high cost of 666 and D.D.T. prevailing, this linear application was the obvious alternative to the broadcast application of insecticide investigated in Series IV.

The seven treatments listed in Table 1 were tested in four randomized blocks. Each of the 28 plots consisted of a strip of soil (100 in. × 4 in.) which had been well tilled by means of a miniature 4-prong garden cultivator. The plots were spaced one yard apart.

On the day of planting the appropriate dusts were distributed evenly over the plots by hand at the rate of 1 oz. to 50 in., and then were stirred into the soil to a depth of about 2½ in. by means of the same cultivator. A row of maize was then planted down the centre of each plot with an average number of 33 grains to each 100 in. of row.

Satisfactory germination ensued and beetle infestation was found to be well distributed through the four blocks of the experiment. On 28th November, when the seedlings were about a week old, 18 beetles were added to each of the 28 rows to augment the natural infestation.

As the experiment proceeded it became obvious that treatments B and C were failing to protect the plants. On the other hand it was clear that rows subject to treatments D, E, F and G were substantially unharmed by black beetle (Table 1).

TABLE 1.
Data Recorded in 28-Row Experiment with Maize, Berry.

Treatment.	Dead Beetles Found 28 Nov./28 Feb.	Plants Killed or Severely Damaged by Beetle 28 Nov. 19 Dec.
A. Control—no insecticide	26	49
B. 0·025% 666 dust (1)	14	47
C. 0·1% 666 dust (2)	25	31
D. 2% 666 dust (3)	196	2
E. 4% 666 on superphosphate (4)	254	0
F. 2% D.D.T. dust (10)	45	5
G. 10% D.D.T. dust (15)	65	1

Statistical Analysis. (*a*) Dead beetles (square root transformation). Significant differences at P=0·05 are: E and D>G, F; G>C, A, B; F>B.

(*b*) Plants killed (inverse sine transformation). Significant differences at P=0·05 are: E, G, D, F>C, B, A.

The treatments varied not only in their protective effect upon plants but also in the mortality of beetles they produced. This marked disparity is indicated in

* Dust No. 9, used in Series II, tests 2 and 3.

Table 1, which shows an extremely high kill of beetles in the higher concentrations of 666 and a relatively low kill in the two D.D.T. treatments.

A striking persistence of the insecticidal effect was observed in rows treated with the higher concentrations of 666, for soil treated in mid-November was still poisoning incoming beetles at the end of February (when observations were discontinued).

At the end of the experiment (28th February) there was an excellent stand of maize in treatments F and G and a good stand of maize in treatment D. This was in striking contrast to the scattered remnants of crop in the rows devoted to treatments A, B and C. Between the above extremes was the yield in treatment E (4 per cent. 666 on superphosphate), which showed the effects of chemical injury.

Conclusion. Under the conditions of this experiment a satisfactory degree of protection from black beetle was secured without apparent ill effect on yield by sowing the seed in narrow strips of soil impregnated with 10 per cent. D.D.T., 2 per cent. D.D.T. or 2 per cent. 666 at the rate of one ounce to 50 in. This is equivalent to nearly 1 lb. of dust to one chain of row.*

This experiment was not designed to test the usefulness of hand application (which is obviously inapplicable to maize growing) but was merely an attempt to select dosages likely to be successful when applied by machinery to large areas.

Series II. Dusts Applied in Narrow Strips by Machine.

A standard make of market-garden tractor (Planet Junior 3 h.p.) was arranged so that the insecticide was placed in the fertilizer box of the tractor and conveyed by flexible tubes into three " boot " shares spaced 3 to 4 in. apart from each other. The tines on the cultivator frame of the tractor were arranged to give maximum stirring of the soil behind the " boots " in a strip 10 in. wide and about 3-4 in. deep. Behind the tractor was coupled a standard one-row maize drill with its seedbox filled with maize. With this arrangement of machinery it was found that seed could be planted in a band of soil fairly well mixed with the desired insecticide.

In the tests with hand application of insecticide (Series I) the treated strips were about 4 in. in width, so that the young plants were growing with only 2 in. of treated soil on either side of them. With weeds controlled by hand cultivation this scheme was satisfactory but it was obvious that tillage by farm implements would have thrown untreated soil around the plants, thus undoing the original treatment. To overcome this disability all tests with the tractor were designed to plant the seed in the middle of a treated strip 10 in. in width. This increase in the width of soil treated naturally necessitated an increased weight of dust per acre in order to maintain the required concentration of 666 or D.D.T. in the soil around the plants.

Below is a brief account of three field tests carried out with machinery arranged as above—i.e. with insecticide fed from the fertilizer box of the tractor and seed maize dropped from the seed box of the maize drill. The figures relating to the dosage rate are approximate only ; they were computed from (i) the weight of dust used, and (ii) the length of row treated and take no account of any irregularities in the rate of application.†

(1) At one farm between Berry and Nowra on 31st January, a test was laid out which embodied three replications of the two treatments (*a*) and (*b*). Treatment (*a*) was 2 per cent. D.D.T. superphosphate (13) at 8·4 lb. per chain (=22 lb., p, p-isomer per 264 chains of row) while treatment (*b*) was control, planted without insecticide or fertilizer. Each of the six plots in the test was 23 yards in length.

* In each acre of maize planted with the rows 2½ ft. apart there is a total of 264 chains of row. In parts of this paper the dosage of active isomer is expressed in pounds per 264 chains as a guide to the cost of treating one acre of crop.

† Such irregularities were fairly frequent with the dusts based on kaolin ; these tended to impact in the flexible tubes conveying the dust from the fertilizer box.

Result. A very heavy infestation of beetles destroyed the seedling maize in all six plots.

(2) Next day, at another farm in the same district, an experiment was set out in four randomized blocks to test :

(*a*) 3·2 per cent. D.D.T.-kaolin (9) at 2·9 lb. per chain (=15 lb. p, p-isomer per 264 chains).

(*b*) Control, no insecticide.

Result. Under very heavy infestation the stand of seedling maize, both treated and untreated, was ruined within three weeks.

Although the treatments investigated in tests (1) and (2) conspicuously failed to prevent crop destruction, they were not entirely harmless to the pest. This was indicated by (i) the presence of a few intoxicated and dead beetles in the treated plots but not in the controls, and (ii) the slower and less spectacular destruction of plants in the treated plots.

(3) At Dapto on 1st February a total of seven parallel rows, each about 60 yards long, was treated as follows, the control rows being interpolated between the treated rows :

(*a*) 3·2 per cent. D.D.T.-kaolin (9) at 2·1 lb. per chain (=11 lb. p, p-isomer per 264 chains).

(*b*) 2 per cent. D.D.T.-superphosphate (13) at 8·5 lb. per chain (=22 lb. p, p-isomer per 264 chains).

(*c*) 2 per cent. 666-superphosphate (6) at 8·5 lb. per chain (=6 lb. γ isomer per 264 chains).

(*d*) Control—no insecticide or fertilizer.

Results. The damage to plants was nowhere great, even in the controls. A small proportion of the plants in treatments (*a*), (*b*) and (*d*) was killed or badly damaged by beetle but in the row which received treatment (*c*) only two plants out of more than 700 showed beetle damage. This freedom from attack was certainly not due to lack of infestation for the row in question became littered with hundreds of dead beetles within a few weeks. This heavy kill of beetles occurred in no other treatment. Moreover, the soil in this treatment remained toxic for at least three months, as shown by the finding of intoxicated beetles up to 30th April, when observations ceased.

No sign of any ill effect due to the chemical could be detected on the plants in any of the treatments in this test. This is also true of tests (1) and (2).

Series III. Dusts Applied Through the Maize Drill.

In 1942 Lloyd[3] used the maize drill as a means of incorporating insecticide in the soil around the seed so that the young plants would be protected from black beetle. The insecticidal dust was placed in the fertilizer hopper and the seed in the seed-box. The substances tested (naphthalene, sulphur) failed to prevent beetle damage.

Using this method of applying the dust, the writer undertook field tests with 666 and D.D.T. near Berry in January, 1946. The following treatments were applied :

(*a*) 4 per cent. D.D.T.-superphosphate (14) at 2·2 lb. per chain (=11·4 lb. p, p-isomer per 264 chains).

(*b*) 10 per cent. D.D.T.-pyrophyllite (15) at 0·55 lb. per chain (=13·7 to 14·4 lb. p, p-isomer per 264 chains).

(*c*) 2 per cent. 666-superphosphate (6) at 2·4 lb. per chain (=1·6 lb. γ isomer per 264 chains).

(*d*) Control, no insecticide or fertilizer.

For the farmer's convenience the layout adopted was a systematic replication in which the treatments followed the sequence *c*, *d*, *a*, *b* in each of the three blocks.

Each of the 12 plots in the experiment was $3^1/_5$ chains in length. The excessively dry condition of the soil necessitated very deep planting, the share being set at least six inches deep so as to place the seed in moist soil.

Results. A good germination of the plants was followed by heavy beetle infestation in all plots. All three rows which received treatment (*c*) developed a rather noticeable sprinkling of intoxicated and dead beetles at the surface—a feature that was not observed in any other treatment. Considering the depth at which the insecticide was planted this result is surprising.

Nevertheless the beetles continued to destroy the plants in all four treatments and one month after planting hardly a trace of the crop remained. This complete failure of crop protection may have been due in part to the deep planting adopted for much of the maize was eaten off at soil level, well away from the poison.

Series IV. Dusts Broadcast and Stirred into the Soil.

Tests under this heading were designed to simulate the conditions which would exist if an entire paddock were topdressed with insecticide and then harrowed to produce a uniformly impregnated topsoil.

(1) *Exploratory Test.*

Before laying down the large replicated experiment (2) (see below) a series of small pilot plots was laid out as a guide to the choice of dosages.

In each treated plot the dust was scattered evenly over the soil and stirred in with a 3-tine garden cultivator so that the topsoil was impregnated with insecticide to a depth of about 3 in.

Four plots were treated as above, each receiving one of the four dusts listed in Table 2. In addition there were three control plots which received no chemical treatment. Maize was sown thickly in all seven plots at slightly less than the depth of cultivation. Soil treatment and sowing were carried out 14th-15th November, 1945.

TABLE 2.

Dust Applied.	Amount of Dust per Sq. Yard.	Computed Equivalents.	
		Total Isomers per Acre.	Active Isomers per Acre.
0·025% 666 (1)	2 oz.	2·4 oz.	0·3 oz. γ isomer
0·1% 666 (2)	1½ oz.	7·3 oz.	0·9 oz. γ isomer
2% 666 (3)	⅔ oz.	64·6 oz.	8·4 oz. γ isomer
2% D.D.T. (10)	1 oz.	96·8 oz.	>92 oz. p, p-isomer

Results. Germination was good in all seven plots and no sign of chemical injury or retardation became apparent anywhere. Severe beetle damage soon appeared in all plots. By 6th December (a fortnight after the emergence of the plants above ground) it was obvious from the number of plants killed that not one of the treatments was capable of preventing ruinous damage by black beetle in maize.

(2) *Replicated Experiment.*

In the light of the experience detailed above, experiment (2) was designed to test the protective value of 666 and D.D.T. at much higher concentrations. The experiment was conducted in three randomized blocks comparing six chemical treatments and an untreated control (see Table 3).

The plots were situated on ground in which black beetle had fairly recently destroyed an October-sown crop of maize. About mid-December the soil, then bare, was harrowed to a fine tilth. Twenty-one plots each measuring 6 ft. × 3 ft. were laid out so that each plot was separated from its neighbour by a buffer area of untreated soil 2 ft. 9 in. in width. Then on 22nd December, 1945, each plot was given the treatment allotted to it (Table 3) and planted with maize the same day. A 3-tine garden cultivator was used to stir the insecticides into the soil.

TABLE 3.

Treatments and Results in Experiment with Broadcast Application of Dusts.

	Treatment.	Computed Equivalent Active Isomers per Acre.	Dead Beetles Collected 1/3/46-4/4/46.
A	2% 666 dust (3) at 2 oz./sq. yd. ..	1·6 lb. γ isomer.	80
B	4% 666 dust (4) „ „ „ ..	3·1 „ „ „	202
C	6% 666 dust (5) „ „ „ ..	4·7 „ „ „	391
D	2% D.D.T. dust (10) at 2 oz./sq. yd.	11·8±0·3 lb. p, p-isomer.	18
E	4% D.D.T. dust (11) „ „ „	23·6±0·6 „ „	39
F	6% D.D.T. dust (12) „ „ „	35·4±0·9 „ „	66
G	Control—no insecticide	Nil.	32

Statistical Analysis (square root transformation). Significant differences at P=0·05 are C>B; B>A, F; A, F>E, G, D; E>D.

It was intended at the outset that the young maize plants in the plots should be artificially infested, but later circumstances forbade this course. The experiment therefore depended wholly on the natural influx of beetles into the plots. However, lack of natural infestation about the time of planting (22nd December) greatly curtailed the amount of data obtainable from the experiment as originally planned. To offset this disability the plots were replanted with maize in March, 1946, soon after the December-sown plants had been harvested. This second planting experienced heavy natural infestation of beetles.

For convenience the growing period of the December-sown crop will be referred to as Phase I, while the remainder of the experiment will be designated Phase II.

Phase I.

The maize planted on 22nd December entirely escaped the 1945 generation of beetles and reached its full height without apparent interference from the 1946 generation. In March, 1946, it was decided to remove this crop from the 21 plots to make room for a fresh sowing.

Although there had been no signs that any treatment was detrimental to the health of plants, the produce of the plots was weighed with the object of detecting any marked correlation between yield and chemical treatment. The yields obtained per 30 feet of row were as follows: treatment C, 62½ lb.; treatment F, 70 lb.; treatment G (control), 65 lb. These differences were not significant.

Maize cut from plots which received these three treatments was sent to the Director, Glenfield Veterinary Research Station, who undertook feeding tests to determine whether plants grown in D.D.T.- or 666-treated soil were harmful to animals ingesting them. The tests were carried out with rabbits, the most susceptible of common animals to D.D.T. poisoning. As none of the experimental animals developed any signs of ill health, it was considered most unlikely that farm stock would suffer any harm on such a diet.

Phase II.

During the second week of March all stumps left from the harvesting of the December-sown crop were removed and one row of maize was planted (12th March) in each of the 21 plots. In each plot the new row was sown in a median position where the soil had remained undisturbed.

Black beetle attack became evident as soon as the plants were above ground and remained severe for some weeks. Although the destruction of plants proceeded much more slowly in treatment C, it soon became obvious that not one of the treatments was able to provide adequate protection against the pest.

Despite their inability to protect plants, certain treatments proved remarkably lethal to beetles which invaded the impregnated soil. In such treatments (notably B and C) intoxicated and dead beetles had been noticed at the soil surface from January onwards. With the removal of the maize crop in early March it was possible to count all beetles at the surface of the plots. Counts were made at intervals during the period 1st March to 4th April and the totals of dead beetles are shown in Table 3 (right-hand column). On each occasion the bodies were removed so as to obviate double counting.

Plots in treatment C showed a striking persistence of insecticidal effect ; up till 24th April (when observations ceased) beetles continued to appear showing symptoms of intoxication, followed by death. This indicates that soil treated with 666 can remain lethal to adult beetles for at least four months.

Main Conclusions from Experiment (2).

D.D.T. and 666, when incorporated in the soil at the rate of 36⅔ lb. (total isomers) per acre, both failed to protect maize sown 11½ weeks later. Neither treatment had any detectable ill effect upon the growth of maize or its fitness as food for animals. D.D.T. applied as above caused a slight mortality of black beetle adults, while 666 at the same dosage gave a very heavy kill of adults. The effect of both insecticides persisted for some months under the conditions of the experiment.

TABLE 4.

Composition of the Insecticidal Dusts Used in these Tests.

1	0·025% 666 (=0·003% γ isomer) dust	Prepared by adding appropriate amounts of kaolin to Dust No. 8 below.
2	0·1% 666 (=0·013% γ isomer) dust	
3	2% 666 (=0·26% γ isomer) dust	
4	4% 666 (=0·52% γ isomer) dust	
5	6% 666 (=0·78% γ isomer) dust	
6	2% 666 (=0·26% γ isomer) on superphosphate	Composition of the dusts as stated by the manufacturers.
7	4% 666 (=0·52% γ isomer) on superphosphate	
8	10% 666 (=1·3% γ isomer) on pyrophyllite	
9	3·2% D.D.T. (=2% p, p-isomer) on kaolin	
10	2% D.D.T. (=1·9% to 2·0% p, p-isomer) dust	Prepared by adding appropriate amounts of kaolin to Dust No. 15.
11	4% D.D.T. (=3·8% to 4·0% p, p-isomer) dust	
12	6% D.D.T. (=5·7% to 6·0% p, p-isomer) dust	
13	2% D.D.T. (=1% p, p-isomer) on superphosphate	Composition of the dusts as stated by the manufacturers.
14	4% D.D.T. (=2% p, p-isomer) on superphosphate	
15	10% D.D.T. (=9·5% to 10%, p, p-isomer) on pyrophyllite	

References.

1. Wallace, C. R. : Agric. Gaz. N.S.W., 56 : 186, April, 1945.

2. ———————— : Aust. Inst. Agric. Sci., 11 : 3, pp. 135-139, 1945.

3. Lloyd, N. C. : Unpublished report, N.S.W. Department of Agriculture, 2, November, 1942.

(Received for publication, 12th July, 1946.)

Soil Carry-Over of the Bean Halo Blight Disease

By

R. D. Wilson, M.Sc., M.Sc.Agr.,
Department of Agriculture, Sydney, N.S.W.

Since the halo blight disease of bean (*Phaseolus vulgaris* L.), caused by *Pseudomonas medicaginis* var. *phaseolicola* (Burk.) Stapp and Kotte, was first recorded in 1926 by Burkholder,[2] it has been established and universally accepted that, as in the case of the earlier recorded bacterial disease caused by *Xanthomonas phaseoli* (E. F. Sm.) Dowson, infected seed is the main source of carry over of the causal organism from one season to the next. Little evidence has, however, been presented concerning the ability of this organism to live over in diseased bean stalks, leaves or other trash or as a free-living organism in the soil and cause infection to crops subsequently planted in the land. Burkholder[3] states that *Ps. medicaginis* var. *phaseolicola* can live for several months in garden loam in the greenhouse. Field observations made by Adam[1] in Victoria gave no evidence of soil carry-over of the disease from one bean-growing season to the next, although there was good evidence of infection occurring from a previous crop where a diseased crop was ploughed under and the land planted with beans again almost immediately. In South Africa, Wager[6] failed to secure infection by planting healthy seed in sterile soil to which either portions of infected plants or cultures of bacteria had been added. He states, " It would appear that the bacteria do not commonly enter the plant through the uninjured root system. The disease probably develops from infected soil when the bacteria are splashed on to the foliage either during irrigation operations or by rain storms." As a result of his observations on an outbreak of halo blight throughout a district in eastern Transvaal in 1935 following a severe storm, Wager concluded, " The soil must have been heavily infected with bacteria throughout the district and the splashings of the storm were necessary to bring about infection."

In reviewing the literature on this subject, it seems desirable that reference should also be made to other bacterial diseases of the bean. In the case of American common blight (*X. phaseoli*) Muncie[4] added diseased bean trash and also pure cultures of *X. phaseoli* to sterile soil and found that this organism could apparently overwinter and cause infection when healthy seeds were planted in such soil. The experiments of Patel[5] showed that *X. phaseoli* could overwinter in both sterilized and unsterilized soil kept in culture tubes under outdoor winter temperatures in Iowa. Zaumeyer[7] reported field observations tending to show that *X. phaseoli* can overwinter on bean straw in the field. The field observations of Burkholder[3] in New York, however, indicated that soil transmission, if it does occur, is of no importance compared with seed transmission, particularly where beans are grown on the same land not more frequently than once in every three or four years. As far as the writer is aware, no evidence has been presented on the carry over in the soil of bacterial wilt (*Corynebacterium flaccumfaciens* (Hedges) Dowson) or of bacterial brown spot (*Pseudomonas syringæ* Van Hall).

Field Observations.

During the 1945-46 season, the writer obtained definite evidence of infection from a preceding halo blight-affected crop. A bean grower at Bega had planted nine acres with seed of the Wellington Wonder variety early in November. By the middle of December, the crop was so severely affected with halo blight that it was apparent that it would be a complete failure. The grower proposed to plough in the crop and replant with the variety Brown Beauty but was persuaded to replant instead

with Hawkesbury Wonder, a variety possessing excellent field resistance to halo blight. The diseased crop was ploughed in towards the end of December and the land replanted about a week later with certified Hawkesbury Wonder seed. On inspection of the seedlings in mid-January, it was found that, throughout the crop there were plants showing definite water-soaked spots on the first leaves indicative of halo blight infection. During the same season, in certification inspections of over 60 acres of Hawkesbury Wonder crops grown from the same line of certified seed, there was no other instance of infection with halo blight, and it is considered that the disease in the Bega crop must have come from the diseased plant debris of the preceding crop ploughed into the soil. Incidentally, the natural resistance of Hawkesbury Wonder was such that an excellent crop was produced with only occasional leaf lesions, no pod lesions and no death of individual plants despite the fact that prevailing conditions were very favourable for the development and spread of halo blight. A similar observation was made several years ago at Maitland, where two seed crops of the Tweed Wonder variety were grown on the same land in the one season, although it is possible that infection in the case of the second crop could have originated from self-sown plants.

In the two cases cited above, there was evidence of infection originating from the preceding crop. However, where a halo blight-affected crop has been ploughed under and the land again planted in the following bean growing season with beans, there has been no definite evidence of infection from the soil in the many cases which have been observed or reported in New South Wales. In some cases there has been a suspicion that infection did occur from the soil, but in every such case any infection that was observed could have originated from the seed or from near by diseased crops. Perhaps the best field evidence on the point comes from the eastern section of the Gosford-Wyong district, where some of the higher land is planted almost every spring with beans, usually with the Tweed Wonder variety, which is very susceptible to halo blight. Sowings are usually made from June to August and conditions are normally favourable for a very rapid spread of halo blight. Field surveys made in this district almost every spring over the last fourteen years have shown that the amount of halo blight in such crops is dependent firstly on the amount of disease carried in the seed and secondly, on the weather conditions during the growth of the crop. If halo blight-free seed is planted and the crop is sufficiently isolated from other crops, the grower can expect a halo blight-free crop irrespective of the halo blight status of the crop grown on the land in the preceding spring.

Longevity of the Halo Blight Organism in Dry Sterile Soil.

Materials and Methods. Twenty-eight test tubes, each containing about 20 grammes of dry sandy loam soil were sterilized in the autoclave and to each tube was added 5 mls. of a beef-extract peptone broth culture of *Ps. medicaginis* var. *phaseolicola*. After inoculation, the tubes, which were numbered 1 to 28, were kept in the laboratory at room temperature. Commencing six months after inoculation and continuing at monthly intervals until 11 months after inoculation, the viability of the halo blight organism was determined in the following manner:

The soil in the tubes was shaken up so as to mix it well. A small portion of the soil in each tube (1-2 gm.) was poured into a tube of beef extract peptone broth. These tubes of broth were kept at room temperature (15° to 20° C.) for about a week and those showing growth as a clouding of the broth were noted. As a further check, needle prick inoculations were then made from the tubes of broth into pieces of bean pods cut into convenient lengths and placed in petri dishes. Infection was recorded when dark green water-soaked spots, typical of pod infection with *Ps. medicaginis* var. *phaseolicola* appeared around the points of inoculation.

Results. In tests carried out 6, 7, 8, 9, 10 and 11 months after the addition of *Ps. medicaginis* var. *phaseolicola* to the soil, the organism was shown to be viable in 17, 18, 11, 12, 4 and 2 tubes respectively. Only one tube (the same one) on each

occasion showed any contamination, i.e. growth in the broth without producing infection when inoculated into pods.

Ability of *Ps. medicaginis* var. *phaseolicola* to Compete in Culture with Saprophytic Organisms.

Materials and Methods. Thirty-six tubes of beef-extract peptone broth were numbered 1 to 36 and inoculated as follows:

Three tubes (numbered 1, 2 and 3) were each inoculated with a water suspension of soil. Three more tubes, numbered 4, 5 and 6, were inoculated on the same day with a few drops of both the soil suspension and a beef-extract peptone broth culture of *Ps. medicaginis* var. *phaseolicola*. The remaining 30 tubes (numbered 7 to 36) were inoculated with the broth culture of *Ps. medicaginis* var. *phaseolicola*. On the following day, tubes 7, 8 and 9 were inoculated with a loopful from tubes 1, 2 and 3 respectively. On each of the succeeding nine days, three of the remaining 27 tubes (10 to 36) were likewise inoculated from tubes 1, 2 and 3. On each of the 11 days after commencing the experiment inoculations were made from the 36 tubes into fresh healthy bean pods cut into convenient lengths and placed, together with a piece of damp cotton wool, in petri dishes. Pod inoculations were made by transferring with a previously-sterilized needle loop some of the liquid from the tubes to the surface of

TABLE 1.

Effect of the Addition of Soil or Seed Infusions to Broth Cultures of Ps. medicaginis *var.* phaseolicola.

Treatment of Broth Tubes Prior to Pod Inoculations.	Period between Addition of Saprophytic Infusion to Culture of *Ps. medicaginis* var. *phaseolicola* and Pod Inoculation.	Pod Inoculation Results.							
		Experiment No.						Total.	
		1		2		3			
		*a**	*b*	*a*	*b*	*a*	*b*	*a*	*b*
Soil or bean seed infusion only.	——	33	0	33	0	33	0	99	0
Ps. medicaginis var. *phaseolicola* only.	——	165	165	165	165	165	165	495	495
Ps. medicaginis var. *phaseolicola* together with soil or bean seed infusion.	1 day ..	33	31	33	32	33	32	99	95
	2 days.. ..	30	9	30	20	30	12	90	41
	3 days.. ..	27	3	27	0	27	0	81	3
	4-11 days ..	108	0	108	0	108	0	324	0
	Totals ..	396	208	396	217	396	209	1188	634

Note.—Soil and bean seed infusions obtained as follows:
Experiment No. 1.—Water suspension of clay loam soil from grounds of University of Sydney.
Experiment No. 2.—Water suspension of sandy soil from Sydney Botanic Gardens.
Experiment No. 3.—A 3-day-old water infusion of 50 bean seeds.
* *a*=number of pods inoculated.
b=number of inoculated pods showing infection within 9 days.

pods and puncturing the pods through these drops with a previously-sterilized needle. About five drops were placed from each tube on to a piece of pod. Infection was recorded when a definite water-soaked area, characteristic of external pod infection with *Ps. medicaginis* var. *phaseolicola*, was noted around the point of inoculation. The pods were kept until nine days after inoculation, when they were discarded. In two other experiments the procedure was exactly the same except that in one a different sample of soil was used whilst in the other a bean seed infusion was used instead of a soil infusion (see Table 1).

Results. The results of the three experiments are given in Table 1. In the case of inoculations with pure cultures of *Ps. medicaginis* var. *phaseolicola*, the time taken for infection to be evident varied from 2 to 4 days, whilst in the case of inoculations with mixed cultures the time taken varied from 2 to 9 days. It is possible that some more infections might have occurred with the mixed cultures if pods on growing plants had been used for inoculation, thus permitting the inoculated pods to be observed for a longer time. The results do show, however, that the infective capacity of a culture of the halo blight organism is very markedly and progressively reduced within a few days when a mixed culture from soil or bean seeds is added.

Infection of Plants from the Soil.

Materials and Methods. Several experiments have been carried out in which seed was sown in soil to which diseased plants or cultures of *Ps. medicaginis* var. *phaseolicola* had been added. One of the experiments involved the use of a plot of land at the Botanic Gardens, Sydney, whilst the remaining experiments were carried out in pots in a glasshouse. Where diseased plants were used as inoculum they were cut up and dug into the soil so that they were completely covered. Pure cultures of *Ps. medicaginis* var. *phaseolicola* were used in the form of beef-extract-peptone broth cultures watered on to the surface of the soil. The periods between the addition of inoculum to the soil and the sowing of the seed ranged from a few hours to eighteen months. In every case seed of the halo blight-susceptible variety, Tweed Wonder, harvested from crops apparently free from any of the bacterial blight diseases, was used. Checks were made on the seed used in each experiment by also sowing seed in non-inoculated autoclaved soil. In all these experiments a total of about one thousand seeds were sown in soil to which inoculum had previously been added. In each experiment the plants were inspected for the presence of halo blight at least once each week, and all diseased plants were removed as soon as observed.

Results. (1) Infection apparently occurred from the soil where inoculum in the form of broth cultures of the halo blight organism was added to autoclaved dry soil which was not watered until planting, 0, 3, 14, 28, 42, 55, 71, 98, 111 and 125 days after adding the inoculum.

(2) No infection occurred in another experiment where broth cultures were used and the period between adding the inoculum and sowing the seed was 68 days, but where the soil was watered twice per week until sown.

(3) Where halo blight-affected plants were cut up and incorporated in the soil in which they had been growing, infection occurred in plants subsequently grown in such soil from seed sown 22, 41 and 52 days after adding the inoculum but not when the periods between adding inoculum and sowing the seed were 64 days, 5 months and various times between 5 months and 18 months.

Discussion.

The experiments and field observations reported above substantiate the field observations of Adam[1] in Victoria. They show that infection can occur from the soil and that the halo blight organism can remain viable in dry sterile soil for a period of at least eleven months. There is no evidence, however, that infection with *Ps.*

medicaginis var. *phaseolicola* can occur from soil once the diseased plant material has rotted and the pathogen has come into active competition with the soil microflora. The experiments (Table 1), in which the addition of soil and bean seed infusions to liquid cultures of *Ps. medicaginis* var. *phaseolicola* resulted in a rapid and marked reduction in infective capacity of the latter, lend support to this view. It is probable that this reduction in infective capacity was caused by a reduction in numbers of the bean pathogen as the result of the competitive effect of other organisms. It may, however, have been due to the introduction of a bacteriophage affecting the halo blight organism or to some inhibiting effect of the saprophytes on the appearance of pod infection. Whilst the conditions in a normal soil may be more favourable for the growth of *Ps. medicaginis* var. *phaseolicola* in competition with other organisms than in a broth culture, it is not unlikely that a similar state of affairs would exist in the soil.

It is concluded that land should not be planted with beans immediately after ploughing under a halo blight-affected crop unless a resistant variety such as Hawkesbury Wonder is used for the second crop. The period which should elapse between ploughing under a halo blight-affected crop and replanting with a susceptible variety would probably depend mainly on the moisture content of the soil and the thoroughness with which the diseased material was incorporated in the soil. On the results of the experiments reported in this paper, the writer is of the opinion that, under normal conditions in most New South Wales bean-growing districts, a period of 3 to 5 months would render soil carry-over of the halo blight disease of no great importance, except possibly in the case of seed crops where absolute freedom from halo blight is desired. Even though there may be little risk of infection with the halo blight organism from the soil where beans are grown once each year on the same land, it does not follow that such a practice is desirable, since, apart from other considerations, it is known that soil carry over of certain other bean diseases, possibly including American common blight (*X. phaseoli*), does occur from one bean-growing season to the next.

Summary.

(1) It has been shown that the halo blight organism can remain viable in dry sterile soil kept under laboratory conditions for at least 11 months.

(2) Beef-extract peptone broth cultures of *Ps. medicaginis* var. *phaseolicola* lose their ability to infect bean pods within about three days after inoculating such cultures with infusions prepared from soil or bean seeds.

(3) Field observations and glasshouse experiments have shown that infection can occur where halo blight-affected plants from a preceding crop have been ploughed under a few weeks prior to planting the second crop.

(4) There is no evidence, however, to indicate that, once the diseased bean tissue has rotted in the soil, *Ps. medicaginis* var. *phaseolicola* can survive as a free-living organism and later cause infection when bean seeds are planted in such soil. It is considered that the soil is unlikely to be a source of carry over of the disease from one bean growing season to the next.

References.

1. Adam, D. B.: J. Agr. Vict., 34: 34-35, 1936.
2. Burkholder, W. H.: Phytopath., 16: 915-927, 1926.
3. ————————: N.Y. (Cornell) Agr. Exp. Sta. Mem. 127, 1930.
4. Muncie, J. H.: Michigan Agr. Exp. Sta. Tech. Bul. 38, 1917.
5. Patel, M. K.: Phytopath., 19: 295-300, 1929.
6. Wager, V. A.: S. Africa Dept. Agr. and For. Sci. Bul. 149, 1936.
7. Zaumeyer, W. J.: U.S. Dept. Agr. Tech. Bul. 186, 1930.

(Received for publication, 12th July, 1946.)

TECHNICAL NOTES

THE RESOLVING POWER OF THE EYE AND THE ESTIMATION OF WOOL FIBRE THICKNESS.

In a note in this Journal[1] it has been suggested that the claims of the wool expert that he can visually discriminate the finer distinctions of quality number by reference to fibre diameter alone are ill-founded, and furthermore that the Helmholz figure of a resolving power (for the human eye) of one minute of arc is high when applied to single wool fibres on a black background. The general conclusions then noted were that

(*a*) Fibres over 40 microns apart in fibre thickness were distinguished readily by all observers.
(*b*) The lower limit for the majority of observers was 15-20 microns difference in thickness.
(*c*) These discriminations could only be made against a black background.

Since then, the point has been raised in discussion that the ten fibres reported upon were mounted on the one card in fixed positions and it was not possible for the observer to place any two of the fibres in juxtaposition for comparison, a method commonly used in practice in fibre thickness comparisons. Another point has been raised in that, in selecting fibres for this examination, the writer selected one or two Corriedale fleece fibres of small thickness and dispersed them among Merino fleece fibres of similar thickness. This is alleged to have been a confusing factor in that it is likely that Corriedale fleece fibres would be more lustrous in appearance than the Merino type fibre and might easily have been estimated as greater in thickness because of the greater intensity of the light reflected from their surfaces, under the same conditions. It must be conceded that in practice the expert is usually aware of the breed of the sheep whose fleece he is examining and may adjust his judgment subconsciously to allow for the expected differences in lustre, when assessing fibre thickness. A third point has been made, that the wool expert makes comparisons with a number of fibres spread conveniently for observation and the impression conveyed by a group may be more satisfactory than when dealing with single fibres.

With these three points in mind, fibres were carefully chosen to the following specification :

(1) That each was reasonably uniform in thickness along its length.
(2) That each was selected from a fleece whose breed was in keeping with the fibre thickness selected.

Specification (1) demands that fibres be selected very carefully as a majority of those examined showed considerable variation along the length of the fibre. The contour (or ellipticity) of the fibre cross-section enters into this variation. Hence it was found necessary to fix $\pm 12\frac{1}{2}$ per cent. of the mean fibre thickness as the limit for "reasonable" uniformity.

Two sets of fibres were mounted, namely :

(*a*) Eleven single fibres of a range of thickness.
(*b*) Eleven groups of a range of mean thickness, each group being composed of ten fibres of similar fibre thickness. (No part of any fibre within the group varied from the mean thickness of 30 measurements of fineness within the group by more than ± 20 per cent., representing a coefficient of variation of 6-7 per cent.

The single fibres and the groups were mounted between microscope slides in such a way that the crimp was just removed from the fibre. The sets were submitted for examination on a black velvet background, and since each unit was mounted between one pair of slides the units in each set could be moved as required and close comparisons effected. The three conditions suggested by discussion were thus fulfilled :

(i) Ease in placing units of the set in juxtaposition.
(ii) Comparison of groups of fibres, as well as single fibres.
(iii) Fibres to be of a thickness typical of the mean for the particular breed of sheep.

It was also insisted that the samples should be examined in the open in the best possible light. On the last occasion they were examined indoors. The observers chosen were composed of ten wool experts, five wool technologists, and eight laymen. There was a remarkably close agreement between the three groups of observers.

The results of these tests are given in Tables 1 and 2.

TABLE 1.
Tests with Single Fibres.

Wool.*	No. of Slide.	Fibre Thickness (in Microns). Mean of 10 Points on Fibre.	Minimum.	Maximum.	No. of Slide in Order Given by 23 Observers.
M	10	13·0	12·0	14·0	10
M	3	19·8	17·5	22·0	11
M	6	21·4	19·0	24·0	3
M	9	21·4	19·0	24·0	9
M	11	21·4	19·2	24·0	6
M	2	23·2	20·5	26·0	2
C	1	28·4	26·0	30·0	1
C	5	33·8	32·0	36·0	5
C	7	42·8	38·0	47·0	7
C	8	43·2	37·5	47·0	8
L	4	48·8	44·0	54·5	4

* M=Merino. C=Corriedale. L=Lincoln.

TABLE 2.
Tests with Groups of Ten Fibres.

Wool.*	No. of Slide.	Fibre Thickness (in Microns). Mean of 30 Measurements.	Minimum.	Maximum.	No. of Slide in Order Given by 23 Observers.
M	6	18·4	15·0	22·0	7
M	7	19·9	16·0	23·5	6
M	1	20·2	16·5	24·0	3
M	4	20·2	16·5	24·0	4
M	3	20·6	16·5	24·5	11
M	11	22·6	18·5	27·0	1
C	8	29·5	24·0	35·0	2
C	2	31·5	25·5	36·0	8
C	10	37·1	30·0	42·0	10
L	5	51·1	44·0	61·0	5
L	9	58·8	47·0	68·0	9

* M=Merino. C=Corriedale. L=Lincoln.

The order in which the 23 observers placed the slides was calculated by allotting points for each of the eleven places. A dissection of these results showed the following :

(1) In the single fibre set, fibres whose mean thicknesses lay within 1·8 and 1·6 microns were not discriminated by the observers as a whole, whereas discrimination was indicated in cases where the differences in mean thickness were nil, 0·4, 1·6, 1·8, 3·4, 5·2, 5·4, 5·6, 6·8, 7·0, 8·4, 8·6 and 9·0 microns. This suggests uncertainty over the lower end of this range.

(2) In the "groups of ten" set, those not discriminated were 0·4, 1·5, 2·0 and 2·4 microns apart, while the means of fibres which were discriminated were different by 0·3, 0·7, 1·8, 2·0, 2·2, 2·4, 2·7, 4·2, 5·6, 6·9, 7·7 microns and greater.

Both of these sets indicate that the observers, on the whole, are liable to confusion in their attempts to discriminate between fibres or groups of fibres, whose mean fibre thicknesses differ by approximately 2·5 microns or less. With differences of the order of 3 microns and upward, reasonable discrimination was effected.

In summary, therefore, with facilities for comparison, the best of lighting, no interference from crimp shape, a black velvet background and no attempt to mix lustrous and non-lustrous fibres—the observers, both expert and lay, were shown to discriminate between both single fibres and "groups of ten" where the mean thicknesses were more than 3 microns apart, but showed confusion when the differences were of the order of 2·4 microns or less.

The Helmholz figure for the resolving power of the human eye as 1 minute of arc is therefore absurdly high when applied to single fibres or groups of wool fibres, viewed under the best of lighting against a black velvet background, with facilities for comparison. Three microns for the normal eye at the "least distance of distinct vision", i.e. 25 cms., subtends an angle of approximately 3 seconds of arc.

Reference.

1. Lang, W. R.: J. Aust. Inst. Agric. Sci., 10: 175, 1944.

W. R. Lang.

Gordon Institute of Technology,
Geelong, Victoria.

(Received for publication, 15th July, 1946.)

POTASSIUM DEFICIENCY IN CITRUS.

Orange trees in parts of the Gosford and Moorlands districts, N.S.W., have for some years past shown a condition of declining health which has been of considerable concern to growers and Agriculture Department officers. Locally the condition is known as "burnt leaf" or "decline". It became particularly widespread in September, 1938, and has since appeared rather irregularly, being much worse in some seasons than in others. Generally the field occurrence of the disorder is limited to a particular soil type, a grey sandy soil, usually low lying, carrying in its uncleared state heavy blue gum (*Eucalyptus saligna*) forest.

The symptoms are most prominent in spring. Affected trees produce a rather weak new growth with small pale leaves and this commonly dies back before reaching maturity. This die-back may commence at the tip, but most characteristically it commences at the base. At one side of the twig, half an inch or so above its attachment to the growth of the previous season, a necrotic spot develops. It spreads around the base of the twig, which yellows gradually and dies. At the same time the mature leaves also show symptoms. Most characteristically they turn a rather bright yellow, commencing at the tip, and then brown off so that at one stage the leaf is green at the base and brown at the tip with a yellow band in the middle. This leaf symptom is much more marked on the northern, sunny side of the tree. At other times of the year the tree presents a poor and bunched appearance, with

numerous dead twigs and dull leaves. In bad cases the tree may be nearly defoliated. Crops of fruit are very light.

Early work showed that the condition was not associated with any pathogenic organism, but analysis of affected leaves and green mature leaves from affected trees showed that the amount of potassium present was small. On a dry weight basis, generally less than 0·2 per cent., sometimes less than 0·1 per cent., compared with 0·25 per cent. to about 1 per cent. for mature leaves from healthy trees. The initial leaf analyses were carried out by Dr. N. H. Parbery, Analyst, Department of Agriculture.

The symptoms shown by mature leaves resemble those of potassium deficiency in citrus obtained by Haas[1] in sand culture. Chapman and Brown[2] described weak laterals with a yellow area on the bark near the main stem in experimentally produced potassium deficiency, but in their experiments the yellow area became green again.

As the characteristic type of twig die-back associated with a basal necrosis does not appear to have been observed previously either in the field or in culture, a series of sand cultures was set up in an attempt to reproduce it under conditions of experimentally produced potassium deficiency.

Methods.

River sand thoroughly washed with water was used in glazed earthenware pots each containing 30 lb. of sand. One-year-old Washington Navel orange trees on rough lemon stock were used. The roots and tops of the trees were severely pruned and all earth washed away from the roots before planting out in early spring.

Differential treatments to groups of six trees were effected by adding solutions whose composition is shown in Table 1.

TABLE 1.
Compositions of Solutions Used in Pot Experiment.

Treatment.	Parts per Million.						
	K	Na	Ca	Mg	NO_3	SO_4	PO_4
(1) Control	234	—	200	48	930	96	95
(2) P_2O_5 lacking ..	234	—	160	48	868	96	—
(3) K lacking, no Na ..	—	—	280	48	868	96	95
(4) K lacking, Na present	—	184	160	48	930	96	95
(5) K and P_2O_5 lacking ..	—	—	280	48	868	96	—

Iron was added as tartrate, and a mixture of minor elements containing suitable amounts of B, Mn, Zn, Cu and Mo was included.

Treatment 2 was included for the purpose of comparing symptoms of phosphate deficiency with those described by Haas.[3] The analyses of "burnt leaf" material from the field suggested that its phosphate content was normal.

Treatment 4 was included to discover whether varying the ratio of divalent to monovalent ions induced variation in symptoms (Haas[1]).

No distinct symptoms developed until the end of the first year and the symptoms of potassium deficiency did not become very marked until the end of the second year.

Results.

Phosphate lacking. The leaves became a dull, slightly bronzed green and irregular necrotic areas appeared on the sides or tips of the leaves. There was no chlorosis. Leaves were shed readily, and further crops of leaves were often small,

and soon developed deficiency symptoms. Few laterals developed and their growth was poor. These symptoms resemble those described by Haas.[3]

Potassium lacking. During the spring and early summer weak shoots developed many of which soon died. In some cases necrotic area developed on one side towards the base of the shoot, and extended around it, leading to the wilting and death of the shoot. This symptom resembled exactly the field symptom of coastal " decline ". During the spring and summer, mature leaves yellowed, became scorched, then were shed. Sometimes they yellowed, then browned off from the tip, but the symptoms often developed more irregularly.

Figure 1.

Twig produced by orange tree suffering from potash deficiency. Note necrotic area near base.

Puckering of leaves occurred, and a severe gummosis developed in the main stem of several trees. In the early part of the experiment the symptoms seemed worse in the trees receiving a high concentration of calcium than in those receiving sodium, but no difference was noted in the later stage.

Potassium and phosphate lacking. These trees grew very little and developed symptoms of phosphate deficiency only. This fact is of interest as leaf samples collected during the experiment showed that the amount of potassium in the leaves from this treatment was 0·3 to 0·4 per cent., whilst from the other treatments lacking potassium it was about 0·2 per cent. (see Table 2).

TABLE 2.

Potassium and Phosphate Present in Orange Leaf Samples after Treatment. (Percentage Composition on a Dry-Weight Basis.)

Treatment.	1½ Years after Planting.		2½ Years after Planting.	
	K	P_2O_5	K	P_2O_5
Control	2·41	0·29	1·71	0·39
Phosphate lacking	3·03	0·12	3·25	0·13
K lacking, no Na	0·19	0·35	0·22	0·41
K lacking, Na present	0·22	0·39	0·22	0·37
K and P_2O_5 lacking	0·33	0·11	0·42	0·15

These figures suggest that the severe symptoms of potassium deficiency in orange trees (leaf yellowing and twig die-back) appear when the amount of potassium in the leaves falls below 0·2 or 0·25 per cent. on a dry weight basis. The high concentration of potassium in trees deprived of phosphate is of interest. It did not cause any potassium toxicity as the symptoms shown were the same as in those deprived of both phosphate and potash, except that the latter grew very little during the experiment.

Conclusions.

1. A necrotic spot occurring at the base of young twigs of orange trees, and appearing as a symptom of " burnt leaf " or " coastal decline " of citrus in N.S.W., has developed under conditions of experimentally produced potassium deficiency.

2. Other symptoms produced in the sand culture experiment resemble closely those described by American workers.

3. Leaf symptoms produced by trees deprived of potassium in sand culture resemble those of " burnt leaf " in the field, but other symptoms obtained in sand culture, gummosis and puckering of leaves have not been observed in the field.

R. H. ARNOT.

Department of Agriculture,
New South Wales.

References.

1. Haas, A. R. C.: Calif. Citrogr., 22: (1), (2), 1936.
2. Chapman, H. D., and Brown, S. M.: Soil Sci., 55: 87-100, 1943.
3. Haas, A. R. C.: Soil Sci., 42: 93-105, 1936.

(Received for publication, 18th July, 1946.)

The Australian Institute of Agricultural Science

MEETINGS OF COUNCIL.

Meetings of Council were held on 2nd April and 4th June, 1946, when notifications of the appointments of principal delegates for the current year were received. The proxy delegates who constitute the Proxy Council in Sydney remain the same. The Hon. General Treasurer (Mr. F. C. McCleery) and the Hon. General Secretary (Dr. F. T. Bowman) were reappointed. Mr. E. J. Waring has been appointed assistant Hon. Secretary.

The suggestion that there should be an *Australian Journal of Agricultural Science* was discussed more fully in the light of Branch views on the subject. Information to the effect that the Council for Scientific and Industrial Research has a proposal for some such journal under consideration will add interest to the discussion of this item set down for the August general meeting of the Institute. Other items on the agenda for this meeting were also considered and in the next number of this Journal we hope to cover their discussion at the general meeting. Proposals for the establishment of a School of Horticulture in Australia, which came from the Tasmanian Branch, and for a Tropical Research Station and College, from the Queensland Branch, were considered. It was decided to refer the Tasmanian proposal to State Branches, with the request that they be reported on by sub-committees of members who were specialists. In respect to the suggested Tropical Research Station, it was decided that its further consideration should await the results of a survey of northern Australia which is being made at present by a party of officers of the Council for Scientific and Industrial Research.

Council approved of the publication of a list of members of the Institute. We hope to publish this list in the next issue and to make provision for the issue of supplementary lists annually, with complete revisions at longer intervals.

Membership.—The following have been admitted to membership of the Institute :

As corporate members :—N.S.W. Branch : Miss Dorothy Frith, H. J. Frith, A. Johnson, Dr. Thelma M. Reynolds and K. Spencer ; Victorian Branch : L. J. Harmsworth and G. P. McGowan ; A.C.T. Branch : W. Ives.

As student members.—N.S.W. Branch : R. G. H. Barbour, L. R. Humphreys, W. R. Stern.

In respect to the subscription of new members, Council resolved that in the event of an application for membership being approved by Council after 30th September in any year, the applicant shall have the option of paying his annual subscription and assuming membership either for that year or for the ensuing year.

MEETINGS OF BRANCHES.

Australian Capital Territory.

A general meeting was held on 6th June, at 8 p.m., when the main business of the evening consisted in screening the following films :

" Menace of Erosion ", N.S.W. Soil Conservation Service.
" For Years to Come ", United States Soil Conservation Service.
" Story of D.D.T.", British Ministry of Information.
" Soil for Tomorrow ", Canadian National Film.

Mr. C. M. Donald prefaced the exhibition with a brief discussion of the history of land utilization and agronomic practices in Australia and the necessity for more active measures to protect the soil. After showing the film on D.D.T., Mr. G. A. H. Helson commented on the use of D.D.T. in the control of agricultural pests. Dr. B. T. Dickson also addressed the meeting.

New South Wales Branch.

At a general meeting on 29th March Dr. F. T. Bowman, special fruit research officer of the N.S.W. Department of Agriculture, gave an address on the subject " Climate in Relation to Fruit Growing ". The distribution of fruit crops was shown on a shire map giving the production of various classes of fruit in 1939. The components of climate discussed were temperature and rainfall. Of the five classes of fruit considered, bananas, citrus, pome and stone fruits and grapes, the first and second classes appear to be limited by winter temperatures. The remaining three classes are not subject to winter injury in N.S.W. and their distribution was considered according to summer temperatures.

The various classes were distributed in the following manner : Bananas are limited to the north-eastern corner of the State, within the July isotherm of 55° F. and to areas where the annual rainfall is 50-60 in. Citrus : the growth of this crop is limited by the August isotherm of 50° F., and on the coast is restricted to areas receiving an annual rainfall of 30-40 in. Inland it is grown under irrigation. Deciduous fruits : commercial areas of deciduous fruits occur within the 55° F. August isotherm, apparently because of the winter cold requirements of these crops. Between the 50° F. and the 55° F. August isotherms there is an extensive zone of mixed citrus and deciduous fruits, but below the 50° F. August isotherm only deciduous fruits are found. Within this major zone the best pome fruit districts are bounded by the 70° F. January isotherm and the 30 in. isohyet. Grapes are distributed about the 75° F. January isotherm in areas with a rainfall of 25 in. per annum, or under irrigation. Stone fruits are widely distributed in the deciduous zone in areas with a 25-30 in. rainfall, or are irrigated.

At a general meeting on 10th May, Mr. R. J. Swaby, Bacteriologist, N.S.W. Department of Agriculture, gave an address on "Organic Matter and Soil Structure". He discussed the formation of crumb structure in the soil, factors influencing the stability of the crumb, the treatments which destroy it, and methods of restoring desirable structure in deteriorated soils.

Queensland Branch.

The President of the Institute (Dr. B. T. Dickson) addressed a well attended meeting of the Branch in May on the "Food and Agriculture Organization of the United Nations". Dr. Dickson dealt with the formation of the Organization and gave in some detail the functions of its various sections. He appealed to members to familiarize themselves with the work of F.A.O. in order that the Institute might play a national part in what was asked of Australia by the Organization.

The July meeting was devoted to Notes and Exhibits. Mr. C. G. Hughes screened a set of slides illustrating the plant-breeding work of the Queensland Bureau of Sugar Experiment Stations. Mr. E. B. Rice exhibited a sample of homogenized cheese prepared for use in the tropics and now being marketed in Queensland. Details of its manufacture and properties were given. Mr. O. St. J. Kent showed a series of commercial butters and butterfats of various shades of yellow and explained the differences in terms of the feed consumed. A note on the hormone-type weed killers was given by Mr. C. W. Winders.

South Australian Branch.

At a general meeting held on 31st May, Messrs. Elliot, Paterson and Breakwell spoke on "Agricultural Education in Agricultural High Schools and Agricultural Colleges". Mr. Elliot gave a general description of the Birdwood Area and discussed the agricultural science curriculum which had been prepared for the Birdwood High School. He pointed out that time was a very limiting factor, especially in regard to practical work. Many of the pupils, especially those that went on to the university, had found the lack of basic science, especially physics, a big handicap. The present aim is to institute general science in the first year, to be followed by two years' agricultural science.

Mr. Paterson outlined the teaching of agricultural science in six schools where he had been. He stressed the points :

(1) That the scope and purpose of agricultural science in high schools depend on the need of the students, including both those who want to go on to university and those who wish to go on the land.

(2) That the high school students need the type of education that will capture their enthusiasm.

He outlined a possible future policy in which the main points were :

Out of a total of 35 teaching periods per week,

(*a*) 25 to be used for basic work—mathematics, languages, etc.

(*b*) 10 to be used for agricultural science, with general science and agricultural science being taught together.

This would give more flexibility and make the high schools more multi-purpose. Practical work could be done more easily and efficiently with a little more equipment.

Mr. E. J. Breakwell took Roseworthy as an example of agricultural colleges. At least 90 per cent. of the students in such colleges will go on to the land and are now getting considerable support from the farming community.

As in the high schools, he made the point of insufficient time and put forward suggestions for overcoming this :

(1) The possibility of extending the course to four years, which would be unpopular in the farming community.

(2) Decreased practical work—this could possibly be done to an extent in the less busy periods of the year.

(3) Decreasing the time given to science subjects. This may be possible in chemistry, a good deal of which is covered in other subjects but it would necessitate qualifications in chemistry as a prerequisite to entry to the college.

(4) Use of typewritten notes for lectures.

(5) More specialization into different branches.

Future progress may lie along three lines :

(1) Better teaching methods.

(2) Use of farms in districts other than Roseworthy for practical work.

(3) Commonwealth and international exchange of ideas.

Mr. John Green, Agricultural Editor of the B.B.C., addressed a general meeting on 11th July on "Recent Developments in British Farming Practices".

During the years 1935-1937 British agriculture was tending to change from its old outlook of marketing boards, commodity prices, etc., to an outlook of soil fertility and land utilization.

One of the big advances in this direction was the practice of ley farming. The old ideas that a pasture, once established, should never be disturbed were being shaken on the one hand by the scientific work of Sir G. Stapleton and on the other by the practical work of Elliot and

others. These latter were making collections of strains of wild white clover and other indigenous grasses, which had proved themselves in old pastures. From these collections they established flourishing pastures in 2-3 years and after grazing them 2-4 years reploughed and cropped the land.

The advent of the war and the resulting cut in imported fodder for stock greatly hastened the practices described and a change over from beef and pig production to dairy cattle. This meant a big increase in land cultivation and fertilizer requirement. Instead of exporting nitrogenous fertilizers as in pre-war days, Britain had difficulty in supplying her own needs. In addition the number of tractors and other implements increased enormously so that quite a lot of the smaller holdings became over-capitalized.

The wartime shortages have also helped to educate the British farmer to feed his stock properly, and this has resulted in a big increase in yield. The dairying expansion and the labour problem have pushed sheep out of the mixed farms on to more marginal, hilly country. This hilly country, however, has deteriorated badly and this fact, together with the poor returns from raising store sheep and cattle, are creating a problem. With approximately 1½ million steers a year from three million dairy cows, the problem of raising the steers as store cattle will have to be faced.

Mr. Green briefly touched the question of economics, stressing the fact that the British farmer was alive to the changes outlined above, and was in an intelligent receptive frame of mind—anxious to exchange ideas with overseas farmers and to gain a better international understanding in agriculture.

During the discussion that followed his address Mr. Green touched on the question of humus and the interest, scientific and otherwise, it had stimulated in Britain ; the value of broadcasting as a means of getting ideas across to the farmer ; the country war committees and their possible future, and possible future trends in the dairying industry.

Tasmanian Branch.

At a Branch meeting held on the 7th May, an interesting talk was given by Mr. L. W. Miller on " Does Spraying Defeat its own Object ? "

Mr. Miller said that at one time the habits of an insect species were thought to be as fixed as its morphological characters. In recent years, however, economic entomologists have been encountering results which suggest that not only can the habits of a species change within a relatively short time, but that these changes appear to be the direct result of our efforts to control pests by the use of insecticides.

The history of the evidence supporting the contention that resistant strains of insects may develop was then discussed from the earliest record in U.S.A. in 1914 ; particular reference being made to Quayle's work on citrus red scale and Hough's on codling moth. The claim that the phenomenon was not restricted to a few species was supported by examples from a wide range of economic pests.

A possible genetic basis for racial segregation in insects was given, the opinion being expressed that if by some cultural practice the environment of an insect was altered, and if there is one occasional mutation which is superior to the general population in its ability to survive the changed conditions, then we have the potentiality for the development of a new race. Whether the race actually develops, and how long it takes depends on quantitative relations.

In dealing with the practical significance of racial segregation, it was pointed out that unfortunately it was the more intelligent grower who is most painstaking in the control of his pests who would first be confronted with the problem. Since it is quite likely that resistant strains will be developed in many of the major pests, many recommendations for pest control will in time prove to be of doubtful value. Until much more is known of the fundamentals underlying the phenomenon, it is impossible to consider the remedy in a rational manner. This probably represents one of the greatest challenges to the economic entomologist.

Victorian Branch.

For the purpose of its meetings, the Victorian Branch is closely linked with the Melbourne University Agricultural Society. The Society's twenty-fourth annual report disclosed a total membership for the previous year of 183, of which 126 were agricultural graduates. Incoming office-bearers were elected as follows : President, Mr. A. A. Lee ; Vice-Presidents, Mr. F. S. Crawford and Miss M. E. H. Cowen ; Secretary, Mr. L. J. Harmsworth ; Treasurer, Mr. A. O'Brien ; Graduate Representative, Mr. B. F. McKeon ; Retiring President, Mr. R. T. M. Pescott.

On 30th May Mr. R. T. M. Pescott delivered his presidential address on " Museums and Their Place in Education, Particularly Agricultural Education ".

On 24th May, Mr. T. O. Mitchell, technical officer for Imperial Chemical Industries of Australia and New Zealand, spoke on " Aids to Agriculture from Chemical Industry ". Mr. Mitchell dealt with the contributions which the chemical industry had and could make to agriculture by way of fertilizers and materials for the control of pests and diseases in plants and animals and for weed control. A great deal of research and investigational work was being done in these fields. The importance of the synthetic nitrogen industry was touched on. Developments with phosphates aim to provide fertilizers which are suitable for use under high rainfall conditions and are less subject to fixation as insoluble iron and aluminium complexes. Extension

of knowledge on the importance of minor elements for plants and animals increases the need for discovering the most suitable forms to use.

The newer insecticides include D.D.T. and " Gammexane ", the latter being a trade name for an insecticide containing appreciable quantities of the gamma isomer of benzene hexachloride. The properties, applications and advantages of these materials were described. The anthelmintics, perchlorethylene, carbon tetrachloride and phenothiazine are now manufactured locally. Phenothiazine was claimed to be the most effective drug known for the treatment of gastro-intestinal parasites of domestic stock.

Mr. Mitchell also referred to the development of organic herbicides, to the improvement of copper and sulphur-containing fungicides and to materials for seed treatment. Active search was ranging over the whole field of organic compounds. The possibilities inherent in the discovery and application of penicillin might be applicable in agriculture.

The Society also held meetings in June and July. At the first meeting Mr. A. J. Vasey spoke on " Some Recent Developments in Agronomy ", while at the second Messrs. W. J. Hosking, N. M. Tulloch and K. M. Silcock dealt with " Sire Survey and Herd Improvement ".

Western Australian Branch.

The annual general meeting was held on 3rd May and the following office-bearers were elected for 1946 : President, Mr. G. R. W. Meadly ; Past President, Mr. G. H. Burvill ; Vice-President, Mr. H. R. Powell ; Secretary, Mr. R. J. Moir ; Treasurer, Mr. A. J. Millington ; Journal Sub-Editor and Publicity Officer, Mr. H. L. Harvey ; Committee Members, Messrs. G. F. Melville, R. C. Rossiter, F. O. Grogan, L. T. Jones ; Hon. Auditors, Dr. L. W. Samuel and Mr. A. M. Stewart ; Student Representative, Mr. C. T. Gates.

Mr. G. H. Burvill delivered his presidential address on " Soil Salinity in the Agricultural Areas of Western Australia ".

Current Notes and News

Retirement of Professor Prescott from the Division of Soils, C.S.I.R.

Professor J. A. Prescott, who since 1929 has held the dual positions of Chief of the Division of Soils, C.S.I.R., and Professor of Agricultural Chemistry at the University of Adelaide, has announced his intention of retiring from the C.S.I.R. position early in 1947. He was appointed Director of the Waite Institute by the University Council in 1938 and it is now his intention to give his undivided time to his University appointments.

Professor Prescott initiated soil investigation for C.S.I.R. and became the first chief of the Division of Soils. His experience with irrigation in Egypt influenced the early direction of the work of the Division on to soils of the Murray Valley. In the laboratory, he saw the necessity for an immediate review of methods for soil analysis—a step which was appreciated by soil workers generally throughout Australia. He soon developed an interest in soil morphology and taxonomy and, working with a keen appreciation of climatic influences on soil development, he was able to establish the broader features of the classification of Australian soils. As early as 1931 he produced a soil map of Australia in his well-known C.S.I.R. Bulletin " The Soils of Australia in Relation to Vegetation and Climate ". His interest in climatology has continued from that time and has resulted in fruitful investigations relating to climatic indices.

It is fitting that, before his retirement from C.S.I.R., he has been able to bring up to date his soil map of Australia, which was published recently in a revised form. Through this and his other lines of work he has had a profound influence on the development of soil science in this country.

The Soil Conservation Service in Western Australia.

Dr. L. J. H. Teakle, who was recently appointed to the new position of Commissioner of Soil Conservation in the W.A. Department of Agriculture, supplies the following note on this newly established Service.

A Commonwealth-wide attack on soil erosion was inaugurated at the conference of Commonwealth and State Ministers held in Adelaide, 26th-29th August, 1936, when it was decided to request all State Governments to set up Soil Erosion and Conservation Committees to coordinate the work in Australia. All State Governments have given effect to this decision and these committees have paved the way for action. Technical services are now operating in New South Wales, Victoria, South Australia, Western Australia and the Commonwealth Territories. It is reported that early action is contemplated in Queensland and Tasmania.

The Soil Conservation Service of Western Australia was established on 27th May, 1946, with the appointment of a Commissioner of Soil Conservation. This Service operates under the Soil Conservation Act, 1945, of Western Australia, as a branch of the State Department of Agriculture, and will carry out its functions in collaboration with other branches, with other Government departments and with local governing bodies.

The Soil Conservation Act provides the Commissioner with wide powers to enable him to survey and investigate soil erosion problems, to disseminate information and to assist farmers

in the control of soil erosion as well as coordinate the policies and activities of Government departments and public authorities with respect to the mitigation of erosion. It is contemplated that, generally, action will most effectively be developed in Western Australia through groups of farmers and districts in order that soil erosion measures may be suitably coordinated over adjoining farms in affected areas, and that the action of individuals may have the backing of neighbours and of the district generally.

As many farms do not possess machinery suitable for constructional work necessary for the mitigation of soil erosion, it is proposed to take advantage of the Agricultural Machinery Pool for the financing of contractors or groups of farmers who decide to purchase appropriate plant to serve a number of properties. The Soil Conservation Service will provide technical assistance to farmers in the design and layout of soil conservation measures, as far as staff and equipment will allow. It will be the responsibility of the farmer to make arrangements for the carrying out of the actual works decided upon.

Agricultural Inheritances in Queensland from the War.

The acreage in Queensland under cultivation jumped from a pre-war average of 1,498,000 (1935-1939) to 1,728,000 in the war period (1940-1944). Mr. McKeon, in his presidential address to the Queensland Branch recently, gave some interesting facts concerning this increase. Potato production, for example, had increased to 6,000 tons in north Queensland, where only a few hundred tons had been produced before the war. Mr. McKeon discussed the navy or canning bean and grain sorghum as agricultural inheritances of the war years. Before the war the annual requirement of navy beans for the Commonwealth was about 2,000 tons, which all came from overseas. The demand increased with the building up of Australia as a forward war base and from a small quantity of seed in 1941 the acreage was increased till there were about 3,000 acres devoted to the crop. The industry has become well established in the south Burnett, Tannymorel and Yangan districts and appears likely to remain. The fact that every operation from sowing to harvesting can be carried out mechanically is a big factor in the success of the crop.

During the war sorghums became important as a source of grain to be marketed in the same way as wheat and maize. It is not suggested that grain sorghum should displace either wheat or maize, but the fact is that sorghums can produce grain under much harsher conditions and will guarantee a crop when the others often fail. The older tall varieties of sorghum had to be harvested by hand and were thus expensive and laborious to manage on a large scale. They were usually confined to small patches and were not grown for sale off farms. The introduction of short, heavily heading varieties, which could be harvested with a header like wheat, undoubtedly paved the way for the tremendous development which occurred between 1942 and 1944, when the area under sorghum doubled and production was practically quadrupled. Production in 1942 was 383,000 bushels from 25,300 acres; in 1944, 1,400,000 bushels from 54,700 acres. The most popular of these new short varieties in order are Kalo, Wheatland Milo and Hegari. The fact that sorghum grain was available proved of tremendous benefit to the poultry industry during periods of shortage; at one acute stage it prevented a virtual collapse of the industry. There is no doubt that the pork and mutton industries also benefited. Whilst the war-time demand will certainly ease and the consumption of grain sorghum be considerably reduced, Mr. McKeon considered that the hardy, mechanically harvested sorghums have come to stay in Queensland.

Probably one of the most important agricultural lessons the war taught is that north Queensland is capable of a much more diversified crop production than was once thought possible. The production of potatoes in the north is a case in point and vegetables have also been grown there very satisfactorily. In the far north, sugar is of course the chief crop, and the coastal plain is virtually under a monoculture of cane. This may have been inevitable in the past, but some rotation must be sought if the fertility of the soil is to be increased and the district given a stable, sound agriculture. There has been a recent development of artificial pasture, and cattle fattening on parts of the wet coast has been very successful. There is room for expansion here as well as with dairy products. Maize on the Atherton Tableland is a very important crop and tobacco production should also be increased. The output of tobacco fell severely during the war years, but even in the best of seasons Australia produces only a quarter of its requirements; nearly half comes from Queensland. Much exploratory work remains to be done, but Mr. McKeon considered that there were large areas between Mackay and Cooktown which would prove suitable for the crop.

Experiment Farms in N.S.W.

Investigational work on the experiment farms of the N.S.W. Department of Agriculture is at present receiving considerable attention. Dr. S. L. Macindoe, who has recently been appointed Principal Research Agronomist in the Division of Plant Industry, is assuming the direct responsibility for plant investigations, staff and organizational matters concerning the experiment farms. A number of conferences on policy, objectives and development have recently been held on the farms under the direction of Mr. H. Wenholz and Dr. H. G. Belschner, Deputy Chiefs of the Divisions of Plant Industry and Animal Industry respectively. Money and staff are factors limiting activities of the dozen or more experiment farms throughout N.S.W. Increased expenditure is not unlikely in the near future, but adequate staffing will depend on the availability of more graduates.

Reclassification in the Western Australian Public Service.

On 18th June, 1946, the Western Australian State Civil Service Reclassification was published. It is to operate from 1st January, 1946. The table herewith compares the new and old salaries of professional officers of the State Department of Agriculture.

The groups are numbered arbitrarily and the increments are automatic within each group. The number of grades in each range is indicated in separate columns.

The hitherto separate groups of third and second class Agricultural Advisers have now been combined in one long range of second class Agricultural Adviser, in which increments are virtually automatic.

Salaries are, as hitherto, subject to variations in the basic wage.

Group.	Office.*	Old Range.†	Grades.	New Range.	Grades.
1	Under Secretary	£890–£1060	4	£864–£1080	5
2	Heads of Major branches	£741– £774	2	£696– £828	5
3	Certain Specialist Officers	£657– £705	3	£624– £720	5
4	Heads of Technical branches	£585– £633	3	£624– £720	5
5	Assistant heads of Major branches	£585– £609	2	£601–£ 649	3
6	Agricultural Advisers (1st Class)	£537– £561	2	£553– £625	4
7	Assistant heads of Technical branches	£441– £513	6	£553– £625	4
8	Agricultural Advisers (2nd Class)	£489– £513	2	£433– £529	6
9	Agricultural Advisers (3rd Class)	£441– £477	4		

* Veterinary officers not included.

† Including £75 basic wage adjustment except in Group 1, which includes £60.

Groups 2 and 5. Branches of Horticulture, Dairying, Wheat, Plant Nutrition.

Group 4. Branches of Botany, Plant Pathology, Entomology, Vegetables, Irrigation, Tobacco, Vermin.

Group 7. Branches of Botany, Plant Pathology, Entomology, Vegetables.

Openings for Agricultural Scientists Abroad.

Empire countries are looking to this country in an increased degree for workers trained in the various branches of agricultural science. Dr. T. Eden, of the Tea Research Institute, Ceylon, who recently spent some months in Australia, has informed the Director of the Waite Institute that his organization is seeking the services of a scientific officer to undertake advisory work and research on soil management in relation to the cultivation of tea. They are looking for a man with experience in soil physics and modern methods of field experimentation. Further information can be obtained from the Waite Institute or Branch Secretaries, who have copies of the advertisement for the position.

Personal Notes

Dr. B. T. Dickson, President of the Institute, and Chief, Division of Plant Industry, C.S.I.R., is one of the Commonwealth's delagates to a meeting of the United Nations Food and Agriculture Organization to be held in Copenhagen early in September.

C. S. Christian is at present leading a scientific survey party in the Northern Territory, and will be away for about five months. The party also includes G. A. Stewart as soil scientist, a geologist and a botanist. The party will make a reconnaissance survey of soils and vegetation in an area lying between 11° and 15° latitude and 129° and 130° longitude. The survey is being made for the North Australia Development Committee which was set up by the Commonwealth Government to define a policy for that part of Australia north of the 20° parallel.

K. R. Norris, of the Division of Economic Entomology, C.S.I.R., has been transferred from Malanda, north Queensland, to Canberra. He will take charge of the sheep blow-fly investigations.

C. A. N. Smith has left the Waite Research Institute to join the staff of the Division of Plant Industry, C.S.I.R., Canberra. He is attached to the Plant Introduction Section.

F. L. Milthorpe resigned from the Biological Branch, Department of Agriculture, at the end of April to take up work at the Botany School, Sydney University, as a Commonwealth Research Fellow in Plant Physiology. He has now been awarded the Farrer Memorial Scholarship and intends to proceed to the Imperial College of Science, London, to work under Professor Gregory on the physiology of frost and drought resistance in cereal crops.

K. O. Campbell has been awarded a Walter and Eliza Hall Scholarship and proposes to undertake post-graduate study in agricultural economics at the University of Chicago and later at other centres in the United States and Great Britain.

V. Lewis and E. P. Baker have been awarded Pawlett Scholarships. Mr. Lewis intends to work at the Massachusetts State Department of Fruit Technology under Professor Carl Fellers on aspects of biochemistry related to fruit preservation. Mr. Baker is going to Davis, California.

E. C. Greacen is going to Berkeley, California, to work on problems of soils and irrigation.

R. N. McCulloch has resigned from the Entomological Branch, Department of Agriculture, to take up the position of Lecturer in the School of Public Health and Tropical Medicine.

G. J. Shanahan has transferred from the Division of Plant Industry to the Entomological Branch, Department of Agriculture.

Miss H. Wrigley has recently taken up duties as Plant Introduction Officer, Division of Plant Industry, N.S.W. Department of Agriculture. She will work in cooperation with the several crop specialists.

W. A. Horsley has resigned from the position of Agrostologist, N.S.W. Department of Agriculture, to enter private business.

Miss M. P. Thomas has been awarded the Fellowship of the International Federation of University Women for 1947. She intends going to Rothamsted late this year to study aspects of symbiotic nitrogen fixation.

Dr. J. S. Hosking has accepted an appointment as Soil Technologist with the United States Sugar Corporation at Clewiston, Florida.

D. C. Swan has been appointed Senior Entomologist in charge of the Entomology Department at the Waite Institute.

Miss N. T. Burbidge is leaving the Waite Institute to take up an appointment with the Division of Plant Industry, C.S.I.R., at Canberra.

G. Blackburn, formerly with the Victorian Department of Agriculture and later the Department of Labour and National Service, has joined the Soil Survey Section, Division of Soils, C.S.I.R.

C. G. Webb, who was at the Mallee Research Station, Walpeup, for eight years, has left the Victorian Department of Agriculture to join the literary staff of the *Weekly Times*, Melbourne.

M. J. Cannon has also resigned from the Department to take up an appointment with the firm of H. J. Heinz and Co. Pty. Ltd. at Richmond, Victoria.

L. F. Mandelson has vacated the position of Tobacco Specialist in the Queensland Department of Agriculture and Stock and has been appointed Pathologist in the Science Branch of the Department.

C. J. McKeon is spending some months in the U.S.A. as Queensland member of a party investigating soy bean production.

W. G. Wells is Queensland representative on the Standing Committee on Soil Conservation.

J. H. Wilson, who recently graduated from the Melbourne University, has taken up duty with the Agronomy Division of the Tasmanian Department of Agriculture.

News has come from A. H. Bishop and G. Richardson, who are on the staff of U.N.R.R.A. in north China. The former is engaged on the restoration of the Grand Canal drainage system. The latter is concerned with agricultural rehabilitation in various districts, including some in the "Communist" zone in North Kiangsu. Both have written interesting accounts of their work and of the immense problems which lie ahead before return is made to the stage of development of 1938.

J. P. Ryland has been appointed operational manager for the Australian Air Lines Commission. Formerly in the Victorian Department of Agriculture, he enlisted in the R.A.A.F. and was awarded a D.F.C. He has 4,500 flying hours to his credit.

Dr. L. C. Snook, who was recently discharged from the A.I.F., has been appointed Animal Nutrition Officer in the W.A. Department of Agriculture in succession to Dr. E. J. Underwood.

Dr. L. J. H. Teakle, formerly Plant Nutrition Officer, has been appointed to the newly created position of Commissioner of Soil Conservation in the W.A. Department of Agriculture.

H. L. Pennington, who was recently released from the Navy, has been appointed Assistant Research Officer in the Division of Plant Industry, C.S.I.R., and is engaged in agrostological problems at the Institute of Agriculture, University of Western Australia. Mr. Pennington joined the Navy after graduating in 1941.